BARR PUMPING ENGINE CO.
GERMANTOWN JUNCTION,
PHILADELPHIA.

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CATALOGUE

OF

DUPLEX STEAM PUMPS,

MANUFACTURED BY

Barr Pumping Engine Company,

Germantown Junction, Philadelphia, Pa.

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BY BARR PUMPING ENGINE COMPANY.

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ADDRESS ALL CORRESPONDENCE TO THE COMPANY.

The Main Office and Works of this Company

ARE AT

GERMANTOWN JUNCTION, PHILADELPHIA, PA.,

[Nineteenth Street and Lehigh Avenue.]

Take the Pennsylvania Railroad Cars to Germantown Junction,

OR THE

Philadelphia and Reading Cars to 16th Street Station.

Both stations are within three squares of our works.

PRICES WILL BE FURNISHED UPON APPLICATION.

Specifications and Estimates will be Furnished for any Special Designs of Pumping Machinery.

PRICES AND SHIPMENTS.

When prices are quoted for pumping machinery, they are for domestic shipment only. No charge will be made for boxing the small parts when pumps are skidded for ordinary shipment. In all cases requiring special boxing, an extra charge will be made, depending on the labor and material used, which will be charged for at net cost.

All shipments by railroad are F. O. B. Philadelphia, unless otherwise agreed upon.

The shipping weight given in connection with any pump in this catalogue is that for the ordinary domestic shipment; when specially caged or boxed, the weight will be correspondingly heavier.

OFFICE OF

BARR PUMPING ENGINE COMPANY,

Germantown Junction,

PHILADELPHIA, PA.

We respectfully ask the attention of users of pumping machinery to the several designs submitted in this catalogue. We are prepared to furnish pumping machinery adapted for every service. As we confine ourselves to the manufacture of pumping and hydraulic machinery as a specialty, with facilities not surpassed in this country, we are enabled to give our customers a better designed, a better built, and a more serviceable steam- or power-pump than can be procured elsewhere, and at a cost, oftentimes, no greater than that paid for some of the imperfectly designed and badly built pumps offered to the trade.

The illustrations in this catalogue correctly represent the general design of our pumping machinery; many of the unimportant details being purposely omitted for the sake of clearness. The general tendency of all progressive establishments being towards the bettering of their designs, we reserve the right to change ours at any time, and any such change shall not be deemed a departure from the spirit and intent of this publication.

THE DUPLEX PUMP

Consists of two steam-pumps, of equal dimensions, placed side by side, with the valve-motion so designed that the movement of the steam-piston of each pump shall have the controlling movement of the slide-valve of the opposite pump; the effect of which is to allow one piston to proceed to the end of the stroke, and gradually come to a state of rest; during the latter part of this movement, the opposite piston then moves forward in its stroke, and also gradually comes to a state of rest; but in its movement forward, and before reaching the end of its stroke, the slide-valve controlling the first piston is reversed, and in consequence the first piston returns to its original position, and in nearing the end of its stroke it, in a similar manner, reverses the slide-valve controlling the second piston; these movements are both uniform and continuous so long as steam is supplied to the pistons. This form of valve-gear enables pumping-engines to be run at any desired rate of speed, fast or slow, and without the intervention of cranks, connecting-rods, fly-wheels, etc.

LENGTH OF STROKE.

In ordinary short-stroke pumps the capacity of the water-end is limited not so much to the piston-speed in feet per minute as by the number of times a valve can safely and noiselessly open and close in a given time. To assume 100 feet per minute as an ordinary speed for pumps has been a time-honored practice; it is obvious, however, that for short strokes it imposes an injurious rate of speed, to which a pump should not, in regular service, be subjected. For example, a pump having

3-inches stroke must make 400 strokes per minute.
4 " " " " 300 " " "
5 " " " " 240 " " "
6 " " " " 200 " " "
7 " " " " 171+ " " "
8 " " " " 150 " " "
10 " " " " 120 " " "
12 " " " " 100 " " "

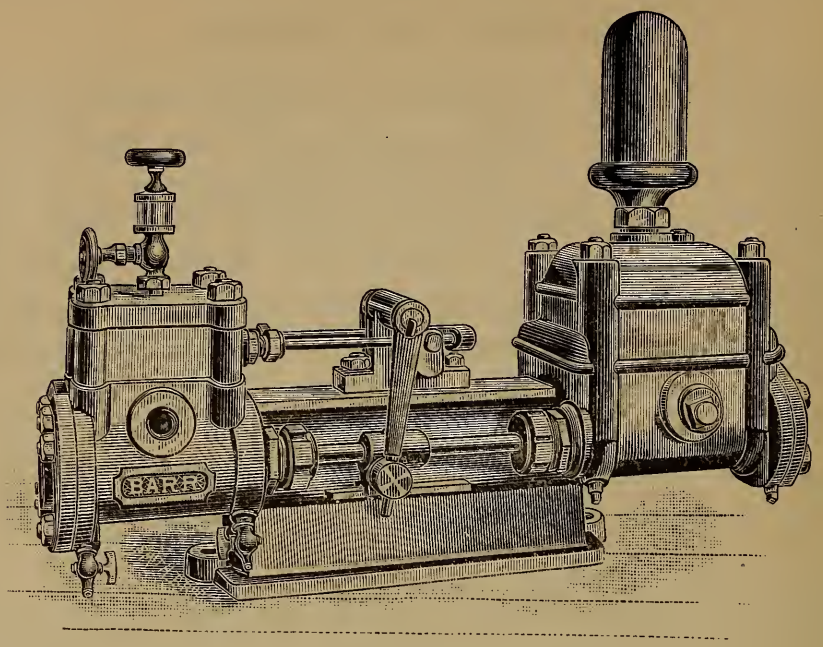
As the above list of strokes represents lengths commonly in use, it needs no argument to show the absurdity of the 100-feet basis of comparison; for pumps having a stroke of six inches and less, the number of strokes as given above is too great for continuous service.

In designing our pumps we have increased the length of strokes for the diameter of plunger somewhat over the usual lengths assigned to duplex pumps. As this does not prevent running up to the number of strokes assigned to the shorter lengths, it is obvious that, for the same number of strokes, our pumps have a much larger capacity.

Table showing the Number of Strokes Required to Attain a Piston Speed from 50 to 125 Feet per Minute for Pumps having Strokes from 3 to 18 Inches in Length.

Speed of Piston in Feet per Minute.	Length of Stroke in Inches.									
	3	4	5	6	7	8	10	12	15	18
	Number of Strokes per Minute.									
50	200	150	120	100	86	75.	60	50	40	33
55	220	165	132	110	94	82.5	66	55	44	37
60	240	180	144	120	103	90.	72	60	48	40
65	260	195	156	130	111	97.5	78	65	52	43
70	280	210	168	140	120	105.	84	70	56	47
75	300	225	180	150	128	112.5	90	75	60	50
80	320	240	192	160	137	120.	96	80	64	53
85	340	255	204	170	146	127.5	102	85	68	57
90	360	270	216	180	154	135.	108	90	72	60
95	380	285	228	190	163	142.5	114	95	76	63
100	400	300	240	200	171	150.	120	100	80	67
105	420	315	252	210	180	157.5	126	105	84	70
110	440	330	264	220	188	165.	132	110	88	73
115	460	345	276	230	197	172.5	138	115	92	77
120	480	360	288	240	206	180.	144	120	96	80
125	500	375	300	250	214	187.5	150	125	100	83

Note.—To find the number of plunger displacements in a duplex pump multiply the number of strokes as given above by 2.



SELF-CONTAINED DUPLEX PUMP.

This pump is designed to meet a popular demand for a simple, compact, well built pump suitable for feeding steam-boilers, house service, locomotives, steam yachts, tugs, etc.

This pump is of the piston pattern, brass lined, metal valves; each pump is furnished with an air-chamber and a lubricator.

Steam-cylinders, 3 inches diameter; water-cylinders, 2 inches diameter. All of 4 inches stroke.

This pump has a displacement of .05 gallon for one stroke of one piston. 15 gallons per minute displacement is had at 150 strokes.

Pipes—steam, ½; exhaust, ¾; suction, 1¼; discharge, 1.

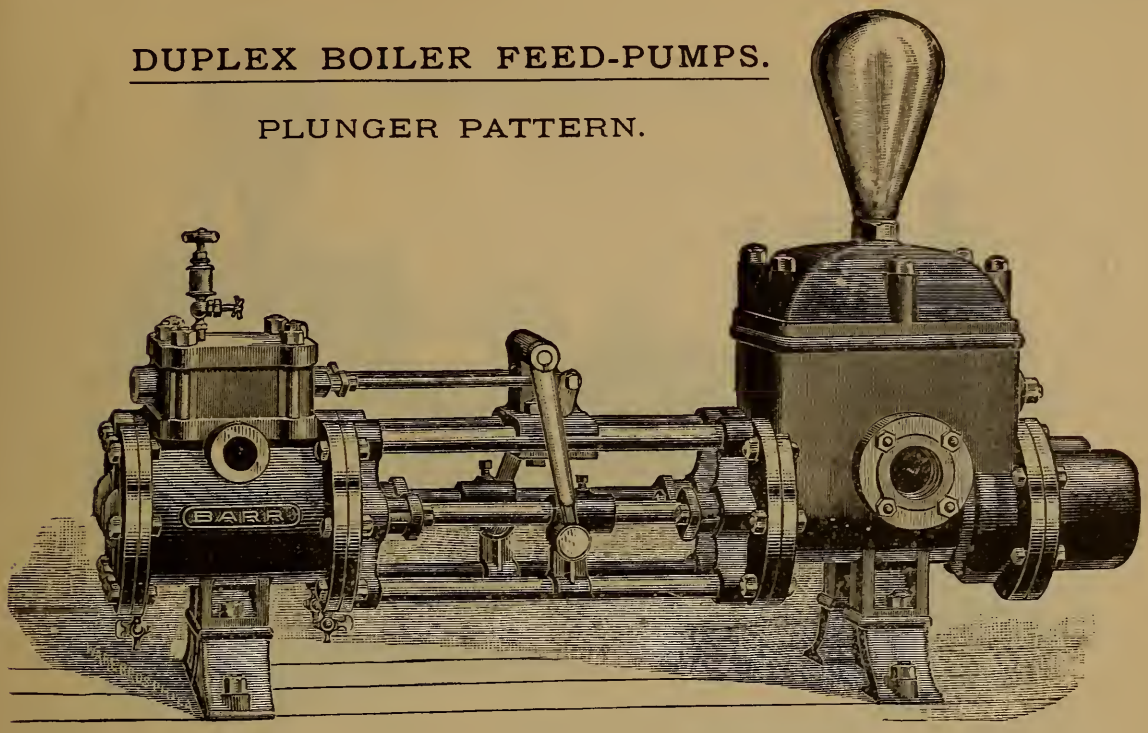
DUPLEX BOILER FEED-PUMPS.

PLUNGER PATTERN.

The engraving on the opposite page represents our standard duplex plunger pump, for feeding steam-boilers, or for any other service where a pressure not exceeding 150 pounds per inch may be required. This pump is noiseless in its operation, has plain, flat slide-valves driven by a positive movement outside of the steam-chest and in plain view at all times; as our valve-motion has no dead-centre, the pump is always in readiness for service. The delivery of water is at all times constant and uniform. The speed can be regulated to the utmost nicety for any required service. Valves will be supplied with the pump for either hot or cold water, as may be desired. In making comparisons it should be borne in mind that our duplex pumps have two steam-cylinders and two double-acting plungers, therefore double the capacity of a single pump of the same dimensions.

DUPLEX BOILER FEED-PUMPS.

PLUNGER PATTERN.



Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	2	5	.068	100 to 200	13 to 27	20	1,200	¾	1	1¼	1	
4	2½	5	.10	100 to 200	20 to 40	30	1,800	¾	1	1½	1¼	
5	2½	6	.12	100 to 175	24 to 42	33	1,980	1	1¼	1½	1¼	
5	3¼	6	.21	100 to 175	42 to 74	58	3,480	1	1¼	2	1½	
6	4	6	.33	100 to 175	66 to 116	91	5,460	1	1½	3	2	
6	3	8	.24	100 to 150	48 to 72	60	3,600	1	1½	2	1½	
6	4	8	.43	100 to 150	86 to 130	108	6,480	1	1½	3	2	
7	4	8	.43	100 to 150	86 to 130	108	6,480	1½	2	3	2	
7	5	8	.68	100 to 150	136 to 204	170	10,200	1½	2	4	3	
8	4	10	.54	75 to 125	81 to 135	108	6,480	1½	2	3	2	
8	5	10	.85	75 to 125	127 to 212	170	10,200	1½	2	4	3	

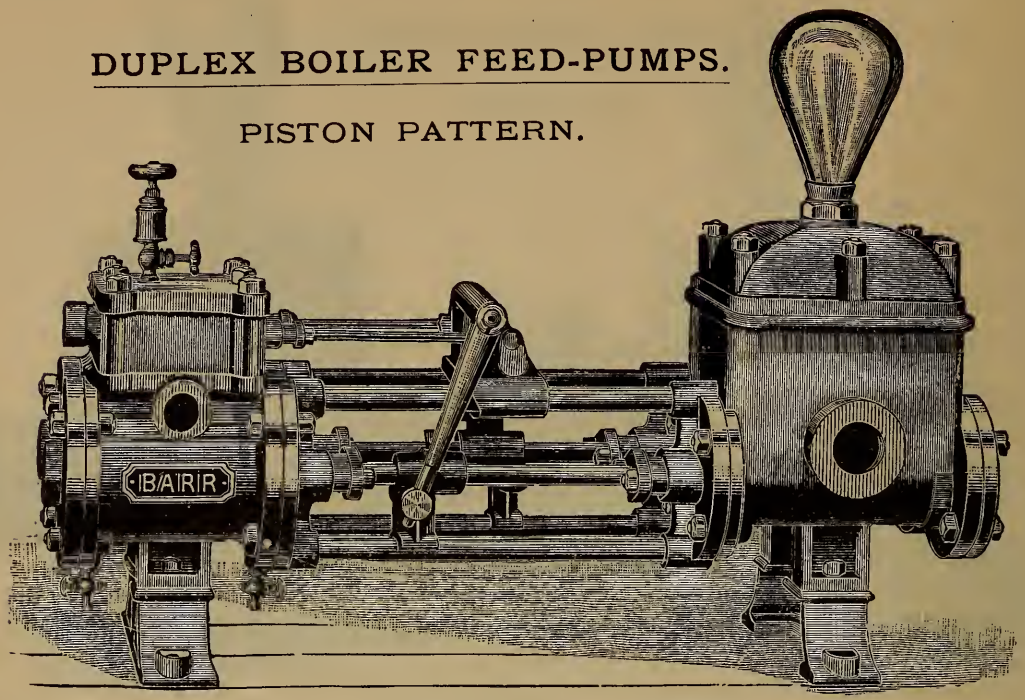
Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke: thus, 4 x 2 x 5 for the first pump in the table, and similarly for any other size.

DUPLEX BOILER FEED-PUMPS.

PISTON PATTERN.



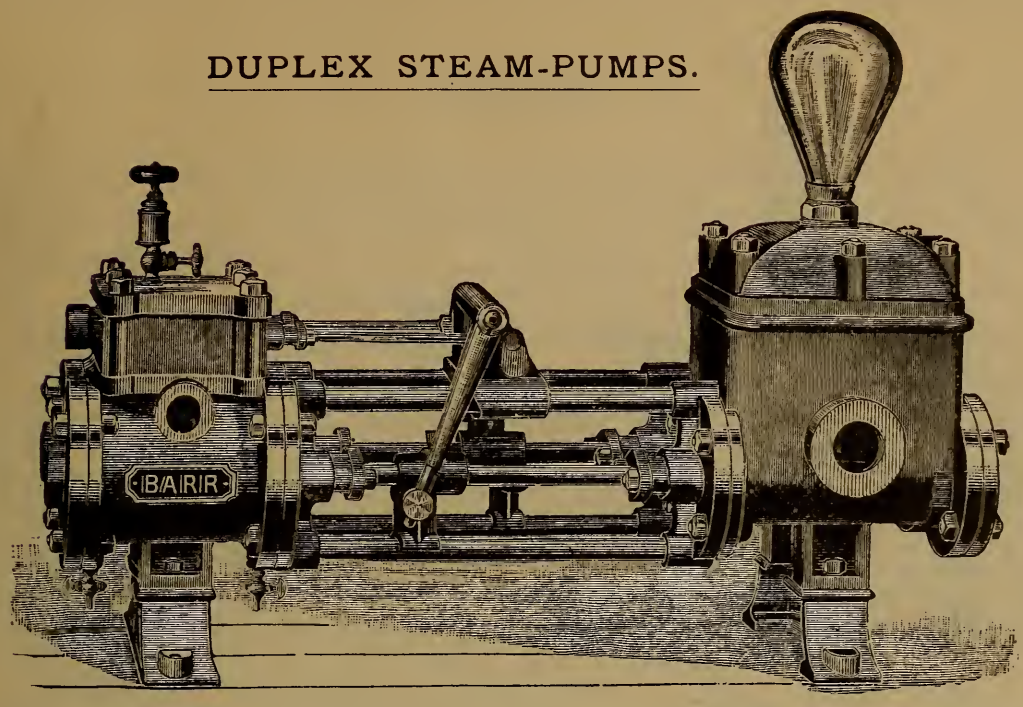
Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	2	5	.068	100 to 200	13 to 27	20	1,200	¾	1	1¼	1	
4	2½	5	.10	100 to 200	20 to 40	30	1,800	¾	1	1½	1¼	
5	2½	6	.12	100 to 175	24 to 42	33	1,980	1	1¼	1½	1¼	
5	3¼	6	.21	100 to 175	42 to 74	58	3,480	1	1¼	2	1½	
6	4	6	.33	100 to 175	66 to 116	91	5,460	1	1½	3	2	
6	3	8	.24	100 to 150	48 to 72	60	3,600	1	1½	2	1½	
6	4	8	.43	100 to 150	86 to 130	108	6,480	1	1½	3	2	
7	4	8	.43	100 to 150	86 to 130	108	6,480	1½	2	3	2	
7	5	8	.68	100 to 150	136 to 204	170	10,200	1½	2	4	3	
8	4	10	.54	75 to 125	81 to 135	108	6,480	1½	2	3	2	
8	5	10	.85	75 to 125	127 to 212	170	10,200	1½	2	4	3	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke: thus, 4 x 2 x 5 for the first pump in the table, and similarly for any other size.

DUPLEX STEAM-PUMPS.



LOW-SERVICE PUMPS LESS THAN 12 INCHES STROKE.

PISTON PATTERN.

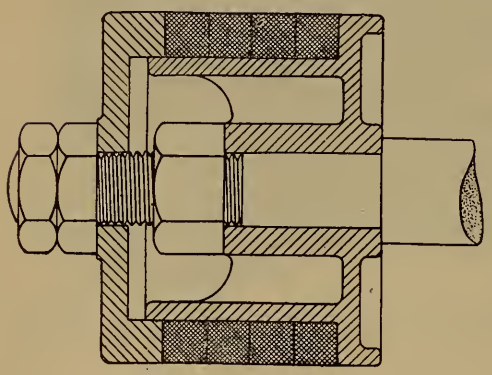
The proportions between the steam- and water-cylinders in the preceding tables are often such as to be quite unsuitable in cases where the lifts are low or the water is to be used under very moderate pressures. In the proportions given in the following table the water-pistons approximate in diameter that of the steam-pistons. These pumps are particularly suited to railroad water-stations, dye-houses, print-works, oil refineries, hotels, laundries, private residences, etc.

Diameter of Steam-Cylinders.	Diameter of Water-Cylinders.	Length of Stroke.	Gallons per Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	3	5	.15	100 to 200	30 to 60	45	2,700	¾	1	2	1½	
4	4	5	.27	100 to 200	54 to 108	81	4,860	¾	1	2	1½	
5	4	6	.33	100 to 175	66 to 115	91	5,460	1	1¼	3	2	
5	5	6	.51	100 to 175	102 to 178	140	8,400	1	1¼	3	2	
6	5	8	.68	100 to 150	136 to 204	170	10,200	1	1½	4	2½	
6	6	8	.98	100 to 150	196 to 294	245	14,700	1	1½	4	2½	
7	6	8	.98	100 to 150	196 to 294	245	14,700	1½	2	5	4	
8	6	10	1.22	75 to 125	183 to 305	244	14,640	1½	2	4	3	
8	7	10	1.66	75 to 125	249 to 415	332	19,920	1½	2	5	4	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

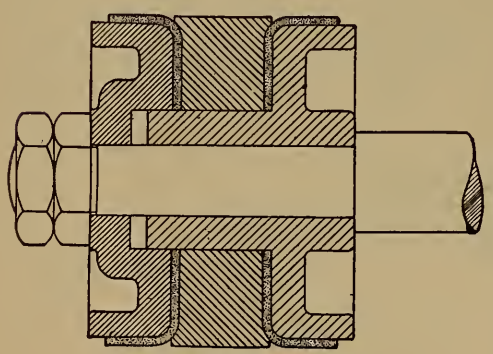
PISTONS.

Pistons for the water-ends of our pumps will be made of any form suited to the work to be done. In general, the kind of piston as shown below, and adapted for fibrous packing, is the one which meets with popular favor for all average requirements. The packing may be of flax or hemp, braided square, and thoroughly saturated with a suitable lubricant or grease; it should be cut in pieces corresponding to the circumference of the piston, and laid in layers one above the other, breaking joints between the alternate layers. When the proper amount of packing has been put in, the follower should be screwed up gently, so as to not compress the layers of packing, otherwise the packing will swell when the water comes in contact with it, and the result will be that the packing will become so tight that it would probably interfere with the smooth and regular action of the pump.



Fibrous Packing.

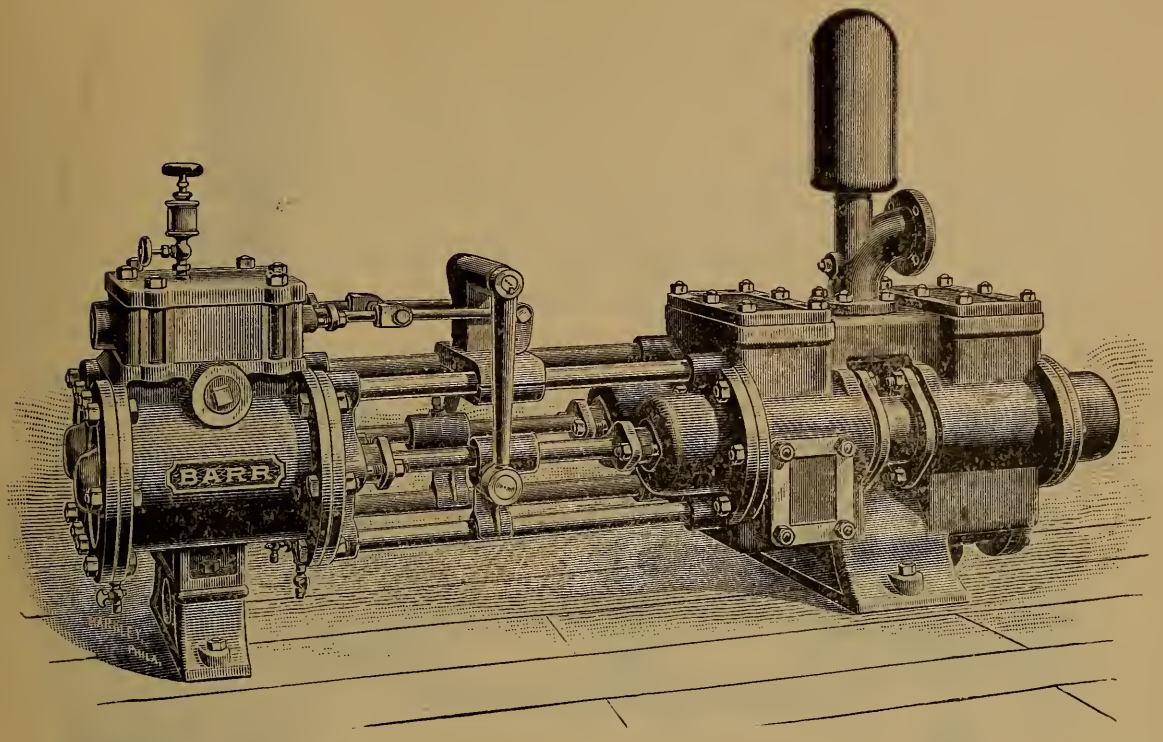
There are cases in which the square flax or hemp packing is not so desirable as some of the forms of combined cotton and rubber packings, especially that known to the trade as Tuck's packing. This is the kind adopted by us for packing the piston-pumps before shipment from our works. When renewing this variety of packing, the same precautions must be observed in breaking joints between alternate layers, and especially in regard to keeping the follower loosely against the packing.



Cup-Leather Packing.

Cup-leather packings are frequently used for special work, and pistons corresponding in style to that shown in the sectional engraving will be furnished with any size of piston-pump, when so designated in the order. We have dies for making the cup-leathers, and can furnish new cup-packings made from specially tanned hydraulic leather.

We can furnish pistons with metallic packing, similar to steam-pistons, where the service seems to require it; in general, we do not recommend such pistons, as they are not so desirable as those adapted for fibrous packing, illustrated above.



CENTRALLY-PACKED PLUNGER-PUMP.

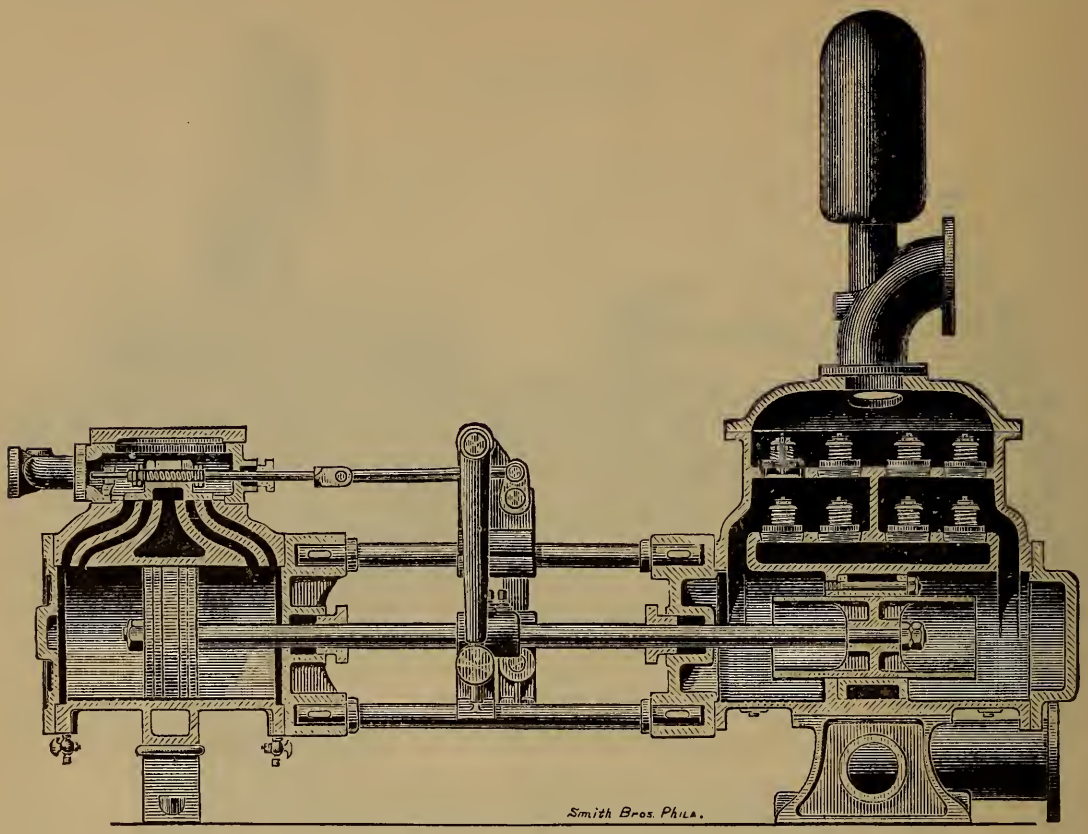
This design is particularly well adapted for use where the water is muddy or contains grit. The plungers are centrally packed with fibrous packing, easily renewable. Valves supplied for either hot or cold water.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
5	2½	6	.12	100 to 175	24 to 42	33	1,980	1	1¼	1½	1¼	
6	3	8	.24	100 to 150	48 to 72	60	3,600	1	1½	2	1½	
8	4	10	.54	75 to 125	81 to 135	108	6,480	1½	2	3	2	
8	5	10	.85	75 to 125	127 to 212	170	10,200	1½	2	4	3	
9	5¼	12	1.12	75 to 125	168 to 280	224	13,440	2	2½	4	3	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	2	2½	5	4	

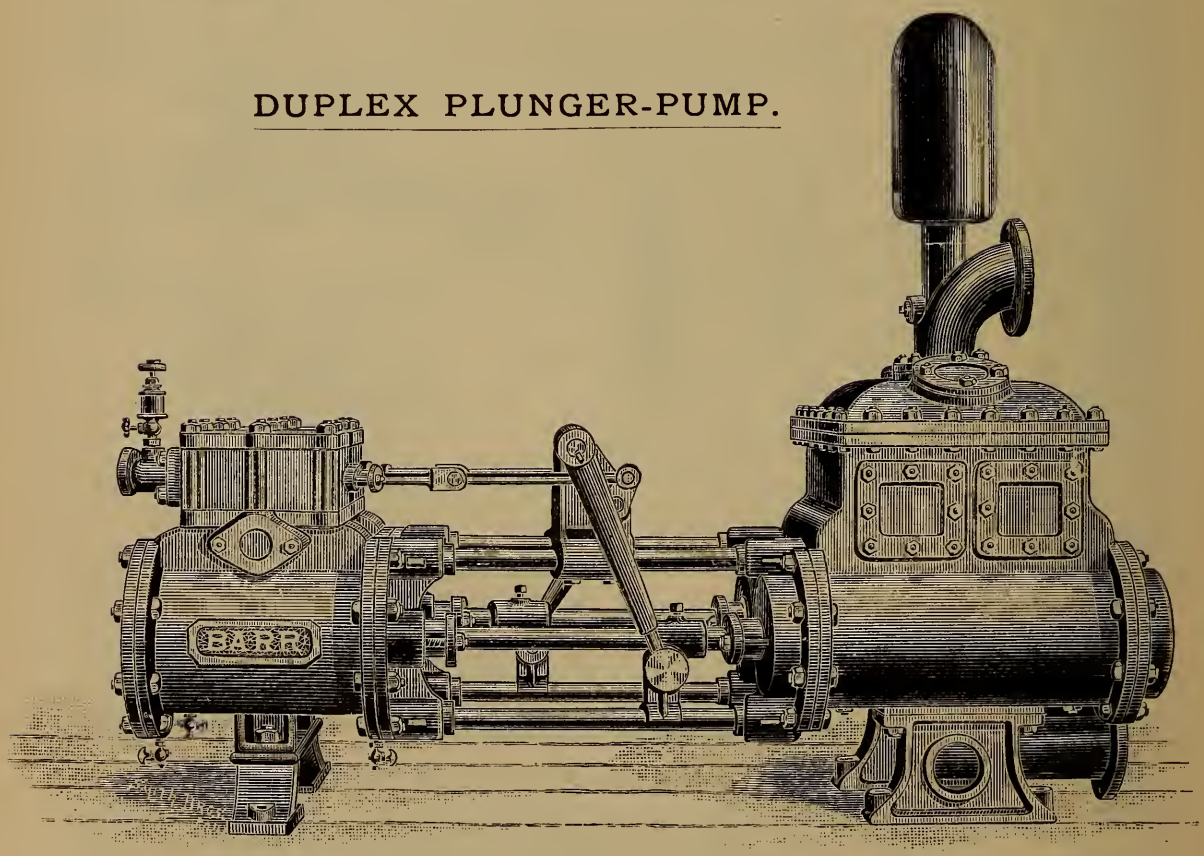
Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 5 x 2½ x 6 for the first pump in the table, and similarly for any other size.



DUPLEX PLUNGER-PUMP.



DUPLEX PLUNGER-PUMP.

This is a most desirable form of pump for small water-works, elevator service, marine service, rolling-mills, steel-works, blast furnaces, etc.

Attention is specially directed to the manner in which the plunger-ring is made and secured to the pump-cylinder. It will be observed that the ring is supported at each end in a bored recess in the cylinder, and is securely bolted to a flange which is cast in and forms a part of the main cylinder-casting, insuring not only a perfect alignment, but the utmost rigidity. The plungers and rings may be easily removed from the pump whenever desired, either for examination or repairs.

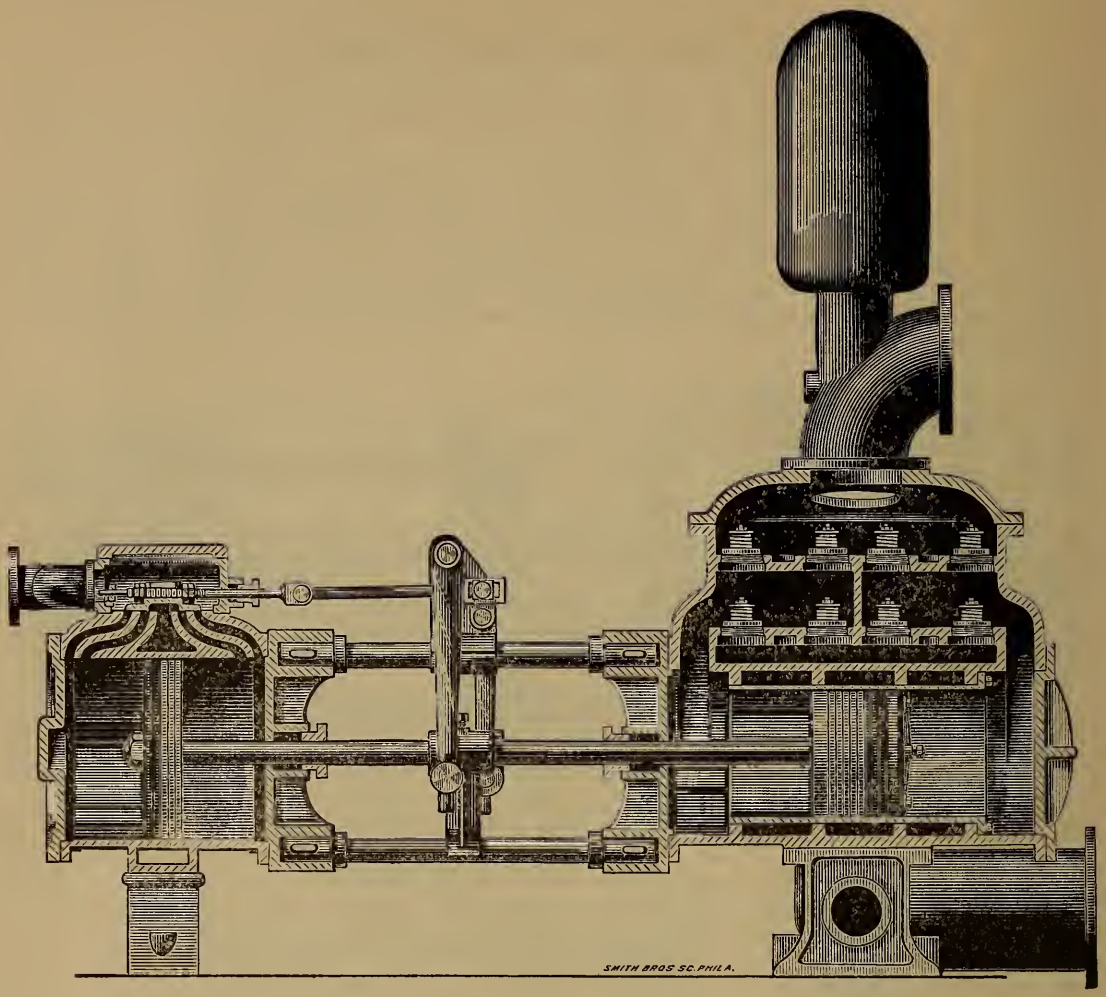
Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
9	5¼	12	1.12	75 to 125	168 to 280	224	13,440	312,560	2	2½	4	3	
10	5¼	12	1.12	75 to 125	168 to 280	224	13,440	312,560	2	2½	4	3	
8	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	5	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	5	4	
10	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	2½	6	5	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	6	5	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	2½	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	3	6	5	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
14	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
16	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
18	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
20	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
22	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	
24	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 9 x 5¼ x 12 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.



DUPLEX PISTON-PUMP.

Piston-pumps having a stroke of 12 inches or more are all made with removable linings, as shown in the above sectional elevation. These linings are made of hard brass, and so arranged that they can be partially turned around in position so as to present a new wearing surface on the bottom should it ever become necessary; or, in case of wear so as to require a new lining, it can be furnished and applied in position without disturbing the pump on its foundation.

The valve-area and water-ways in these pumps are very large, and admit of high speeds without noise or concussion.

These pumps will be specially fitted for any service out of the usual practice. In comparing these pumps with single-cylinder pumps, the fact that ours has two double-acting pistons, and, therefore, double the capacity of the single-cylinder pumps, must not be overlooked.

DUPLEX STEAM-PUMPS.

PISTON PATTERN FOR GENERAL SERVICE.

These pumps are all double-acting and fitted with rubber valves, brass seats, guards, and springs suitable for pumping cold water. Metal or any other kind of valves can be furnished, together with special seats, guards, and springs suited to any particular requirement.

Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
8	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	5	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	5	4	
10	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	2½	6	5	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	6	5	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	2½	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	3	6	5	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
14	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
16	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
18	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
20	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
22	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	
24	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	
18	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	3½	5	12	10	
20	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	3½	5	12	10	
22	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	4	6	12	10	
24	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	4	6	12	10	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke; thus, 8 x 6 x 12 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.

DUPLEX LOW-SERVICE PUMPS.

The proportion of steam-piston to plunger area in the preceding tables is often greater than is necessary for low lifts or moderate pressures. In the list of pumps given below the steam-pistons are, with but few exceptions, less in diameter than the pump-plungers.

This is a pump well adapted for print-works, bleacheries, railroad water-supply stations, tank service for oil lines, etc.

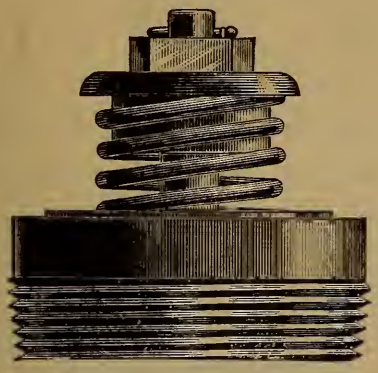
Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
6	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
7	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
8	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
6	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	1½	2	6	5	
7	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	1½	2	6	5	
8	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	1½	2	6	5	
6	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	1½	2	6	5	
7	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	1½	2	6	5	
8	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	1½	2	6	5	
9	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	2½	6	5	
6	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	1½	2	8	7	
7	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	1½	2	8	7	
8	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	1½	2	8	7	
9	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2	2½	8	7	
10	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2	2½	8	7	
6	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	1½	2	10	8	
7	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	1½	2	10	8	
8	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	1½	2	10	8	
9	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	2	2½	10	8	
10	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	2	2½	10	8	
12	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	2½	3	10	8	
10	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	2	2½	12	10	
12	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	2½	3	12	10	
14	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	3	4	12	10	
16	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	3	4	12	10	

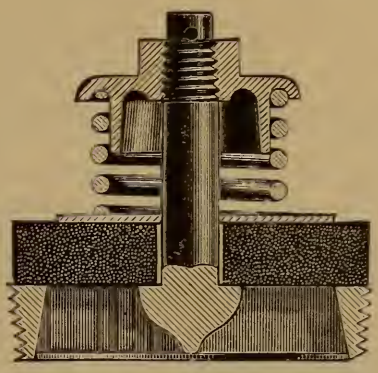
Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 6 x 6 x 12 for the first pump in the table, and similarly for any other size.

VALVE-SEATS.





The valve-seats are screwed into place, the valves being of vulcanized rubber carefully selected for the purpose. On the top of each valve is a brass plate to distribute the pressure and relieve the valve of the destructive action of the spring. The valve-stem and valve-seat, as designed for our pumps, are both contained in the same casting, so that the stem can never wear or shake loose. Parallel spiral-springs are used. The valve-nut screws on a taper thread cut on top of the stem; immediately over the nut a hole is drilled through the stem and a brass split-pin inserted, so that under no circumstances short of actual breakage can a valve ever get adrift in water-ends of our construction.

VALVES.

Customers will greatly aid us in the selection of valves if, when ordering a pump, they will specify the kind of liquid to be pumped, and whether it is hot or cold.

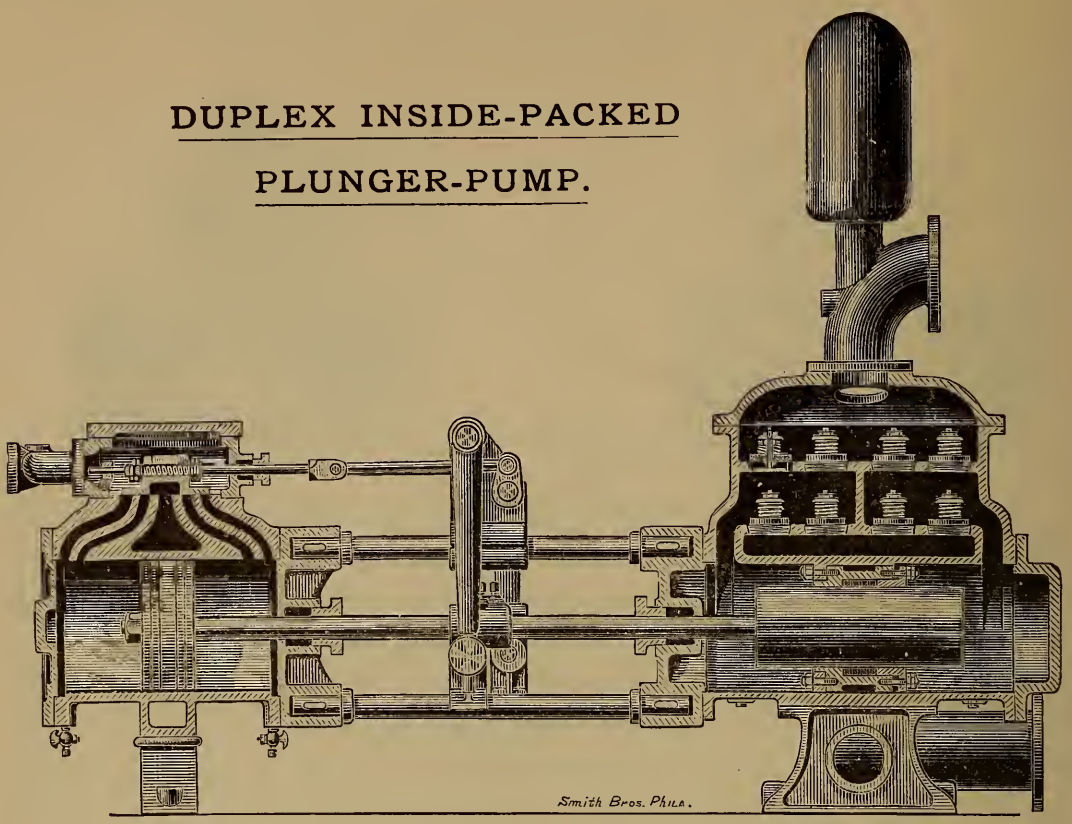
For cold water we furnish a moderately soft vulcanized valve, which will easily adapt itself to the seat to which it is fitted.

For hot water we use a hard vulcanized valve, specially prepared for this kind of work. These valves being inflexible, are carefully ground and scraped to face plates to insure their being perfectly flat; or, if preferred, we will furnish brass valves, faced and scraped true as above.

For alkaline liquor we furnish malleable-iron valve-seats and nuts, with steel springs. The valves will be either of malleable iron or any composition which will remain unaffected by chemical action.

For weak acids gun-metal valves are usually preferred. By reason of the varying effects of different acids upon the ordinary metals of construction, we should be advised as to the kind and strength of acidulated liquor to be pumped. We will then fit the valves and seats so as to best withstand any corrosive action.

DUPLEX INSIDE-PACKED PLUNGER-PUMP.



The inside-packed plunger-pump, as shown above, is a modified form of the one illustrated on page 12. It preserves all the valuable features contained in our regular plunger pattern, the addition of a stuffing-box and gland, adapted for packing the plunger with a flexible or fibrous packing, constituting the only change.

This pump is chiefly desirable in localities where the water supply is muddy or contains gritty matter. Tuck's packing is recommended for use in these pumps, and one set will be included in the pump at shipment. This form of pump is to be preferred over a piston-pump for gritty water, inasmuch as the cost of a new plunger is very much less than that of a new lining. There is the further advantage in the fact that slight reductions can be made in the diameter of the plunger by turning in a lathe to remove the scoring incident to the service in which it may be employed, the difference in diameter being made good by the use of a thicker packing.

The engraving shows the pump fitted with end-suction; this being the most convenient, is the one generally adopted by engineers. We will, whenever desired, fit pumps with a cross-suction pipe, so that a suction connection can be had on either side of the pump; or, in case of two sources of supply, either may be used by simply shutting off the one not needed.

DUPLEX STEAM-PUMPS.

INSIDE-PACKED PLUNGER PATTERN.

The engraving on the opposite page represents our standard design for duplex steam-pump, fitted with inside-packed plunger. These pumps are all double-acting and fitted with rubber valves, brass seats, guards, and springs suitable for pumping cold water. Metal or any other kind of valves can be furnished, together with special seats, guards, and springs suited to any particular requirement.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
8	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	5	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	5	4	
10	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	2½	6	5	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	6	5	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	2½	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	3	6	5	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
14	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
16	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
18	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
20	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
22	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	
24	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

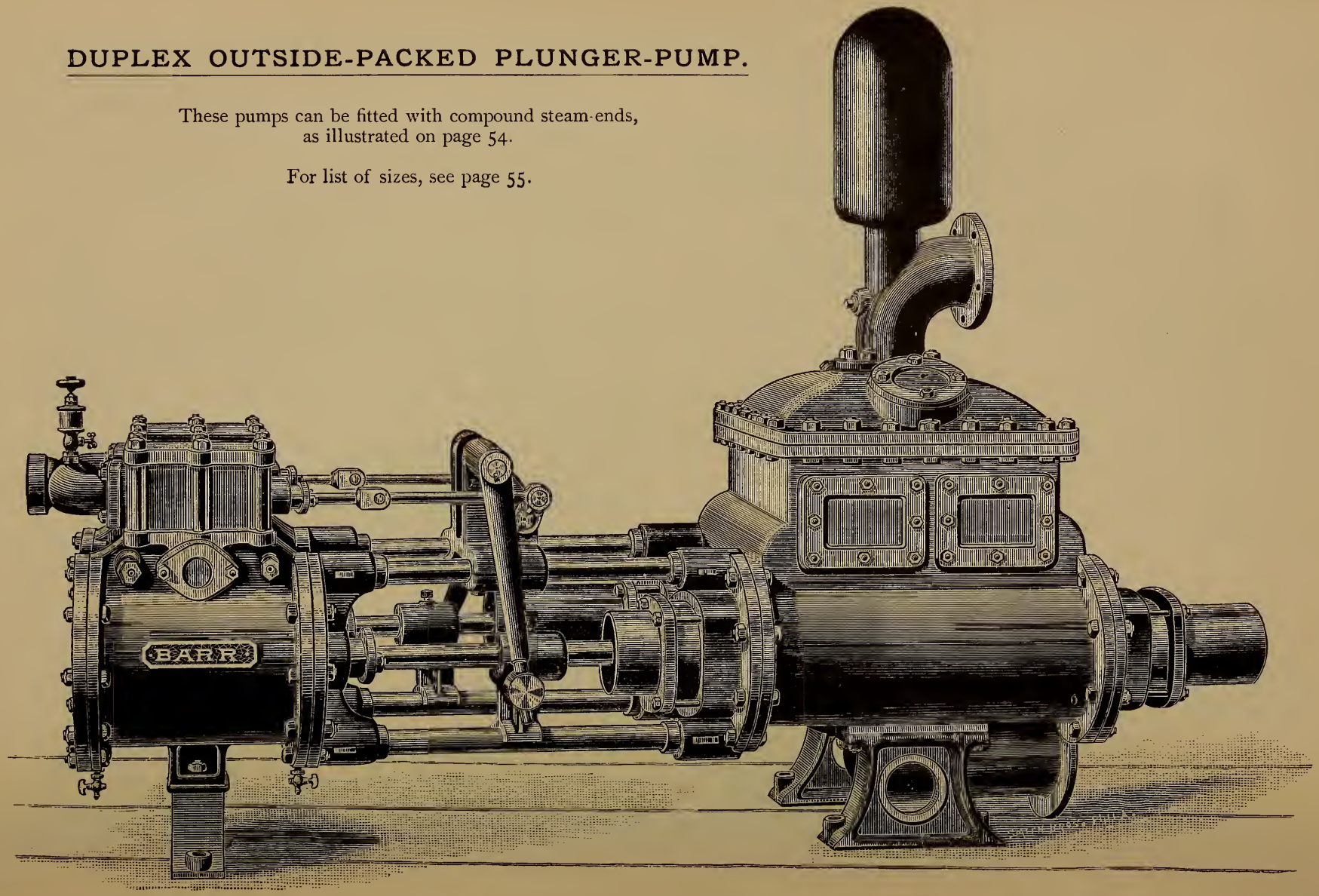
Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 8 x 6 x 12 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.

DUPLEX OUTSIDE-PACKED PLUNGER-PUMP.

These pumps can be fitted with compound steam-ends, as illustrated on page 54.

For list of sizes, see page 55.



DUPLEX STEAM-PUMPS.

OUTSIDE-PACKED PLUNGER PATTERN.

The pump illustrated on the opposite page is of a type much in favor with furnace, rolling-mill, and steel-works managers. The only advantage which it possesses over the one shown on page 18 is that the plungers have outside stuffing-boxes, and are, therefore, much more easily examined and packed.

This type of pump is also largely used in the Western States for water-works service, and is the simplest and best form of outside-packed plunger-pump now offered to the trade.

These pumps are all double-acting and fitted with rubber valves, brass seats, guards, and springs suitable for pumping cold water. Metal or any other kind of valves can be furnished, together with special seats, guards, and springs suited to any particular requirement.

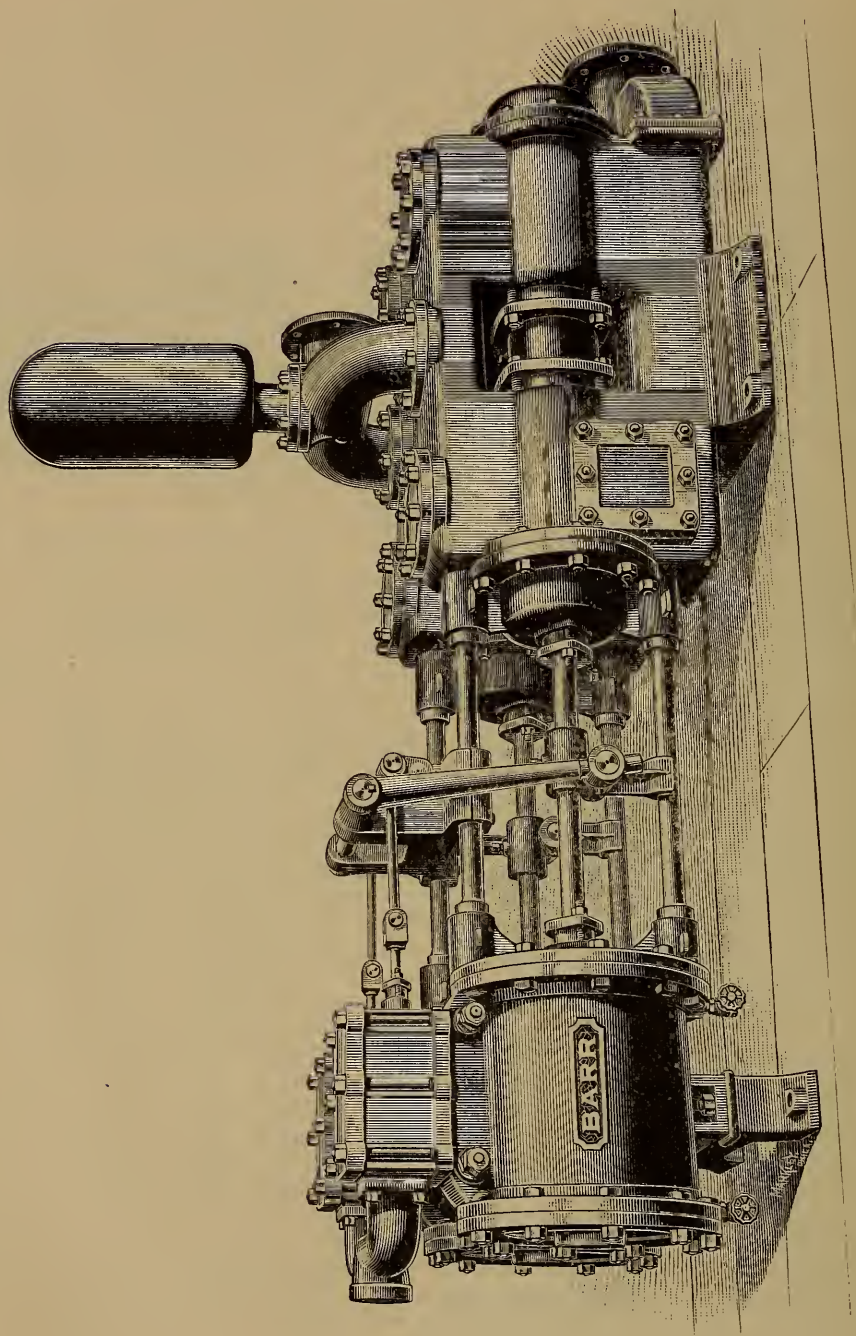
Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	5	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	5	4	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	6	5	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	3	6	5	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
16	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
18	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
20	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
22	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	
24	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 10 x 6 x 12 for the first pump in the table, and similarly for any other size.

DUPLEX CENTRALLY-PACKED PLUNGER-PUMP.



Size, 14 x 7 x 12.

These pumps can be fitted with compound steam-ends, as illustrated on page 54.

For list of sizes, see page 55.

CENTRALLY-PACKED DUPLEX PLUNGER-PUMP.

This style of pump is well adapted for use in any locality where the water is muddy or contains grit. The water-end is made of two separate castings, which permits the use of steam-cylinders of a larger diameter than in the standard plunger pattern.

The stuffing-boxes are large and deep, and adapted for the use of Tuck's or other fibrous packing.

This water-end is well suited to higher pressures than 150 pounds per square inch. We shall be glad to submit designs for pumps of this style suitable for any required pressure.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.-			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
8	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	5	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	5	4	
10	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	2½	6	5	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	6	5	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	2½	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	3	6	5	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
14	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
16	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	4	10	8	
18	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
20	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3½	5	10	8	
22	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	
24	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	4	6	10	8	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

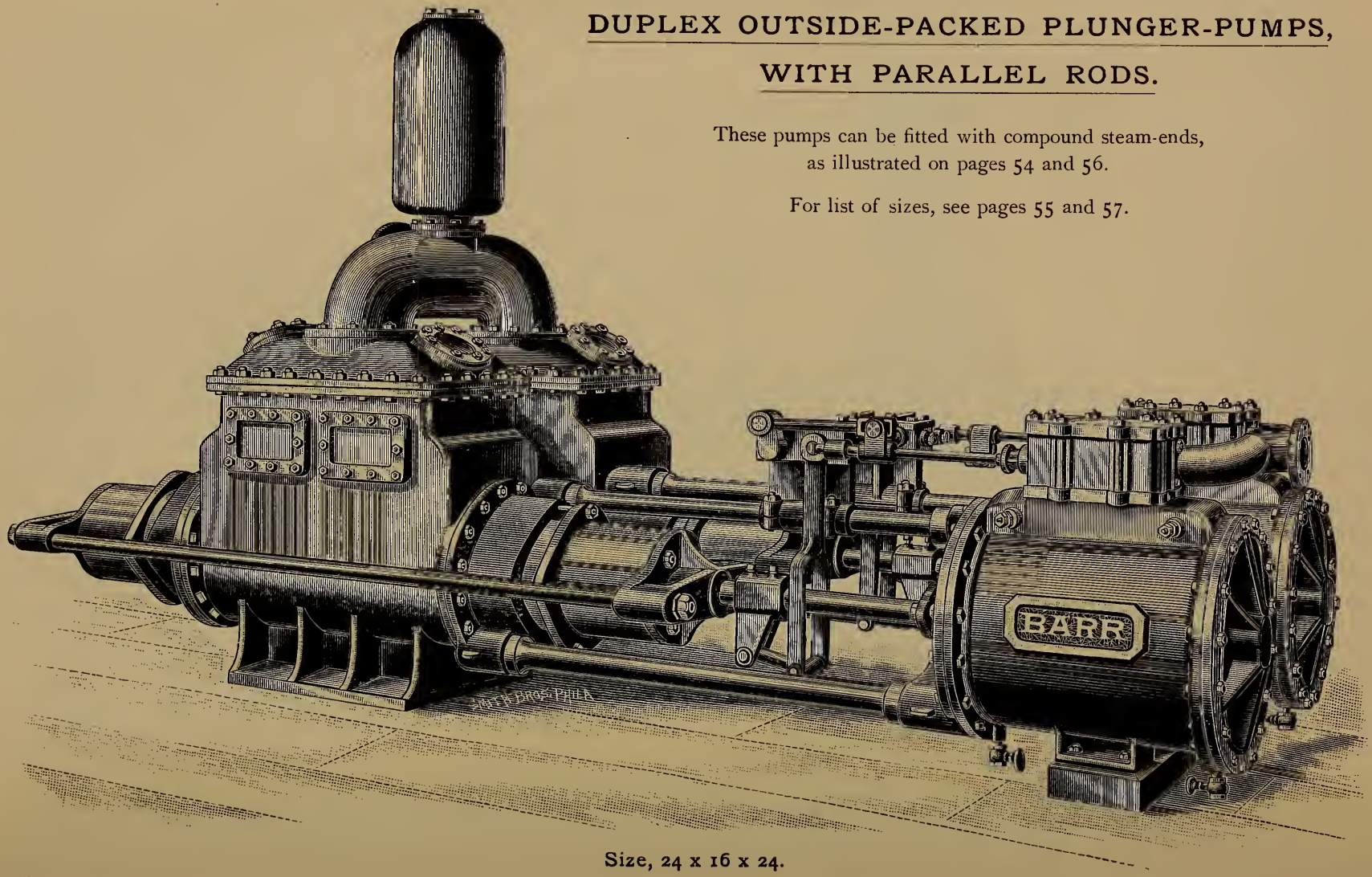
Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 8 x 6 x 12 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.

DUPLEX OUTSIDE-PACKED PLUNGER-PUMPS, WITH PARALLEL RODS.

These pumps can be fitted with compound steam-ends, as illustrated on pages 54 and 56.

For list of sizes, see pages 55 and 57.



Size, 24 x 16 x 24.

DUPLEX OUTSIDE-PACKED PLUNGER-PUMPS, WITH PARALLEL RODS.

This type of pump is the one generally employed in steel-works, rolling-mills, blast furnaces, etc., for tank service and general supply. The muddy and gritty water incident to the sudden rise of a river after a severe storm, has little or no effect on the plungers, which are loosely packed with fibrous packing.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.			Diameter of Pipes in Inches. (Subject to Change.)				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
12	10	18	6.12	53 to 80	648 to 979	814	48,837	1,172,092	2½	3	10	8	
14	10	18	6.12	53 to 80	648 to 979	814	48,837	1,172,092	3	4	10	8	
16	10	18	6.12	53 to 80	648 to 979	814	48,837	1,172,092	3	4	10	8	
18	10	18	6 12	53 to 80	648 to 979	814	48,837	1,172,092	3½	5	10	8	
14	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3	4	12	10	
16	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3	4	12	10	
18	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3½	5	12	10	
20	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3½	5	12	10	
16	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3	4	12	10	
18	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3½	5	12	10	
20	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3½	5	12	10	
22	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	4	6	12	10	
24	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	4	6	12	10	
18	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3½	5	14	12	
20	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3½	5	14	12	
22	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	4	6	14	12	
24	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	4	6	14	12	
26	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	5	7	14	12	
20	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	3½	5	14	12	
22	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	4	6	14	12	
24	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	4	6	14	12	
26	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	5	7	14	12	
28	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	5	7	14	12	
24	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	4	6	16	14	
26	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	5	7	16	14	
28	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	5	7	16	14	
30	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	6	8	16	14	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates.

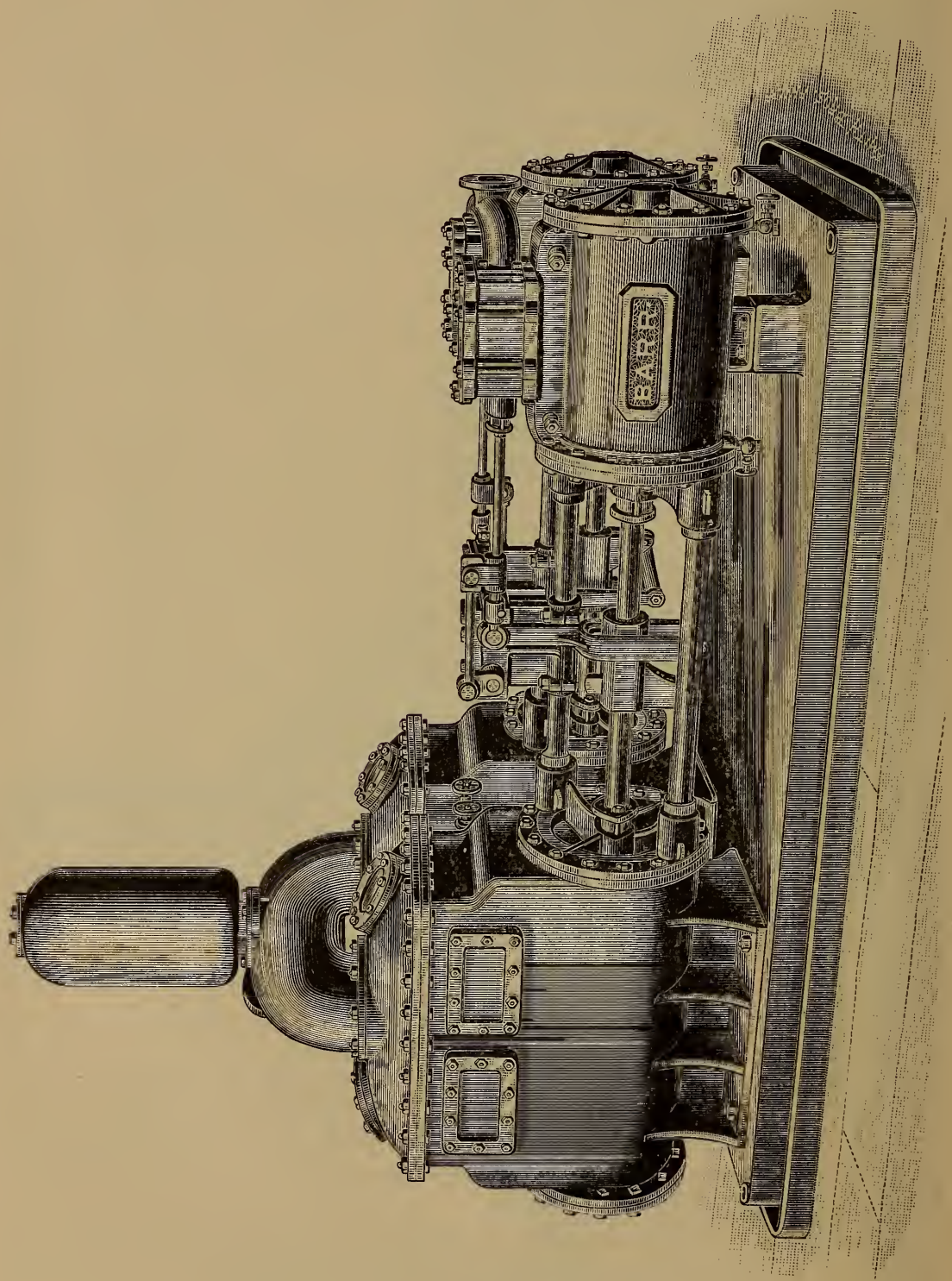
Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 12 x 10 x 18 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.

DUPLEX PUMPS 18 AND 24 INCHES STROKE.

These pumps can be fitted with compound steam-ends, as illustrated on pages 54 and 56.

For list of sizes, see pages 55 and 57.



Size, 20 x 16 x 24, mounted on bed-plate.

DUPLEX PUMPS 18 AND 24 INCHES STROKE.

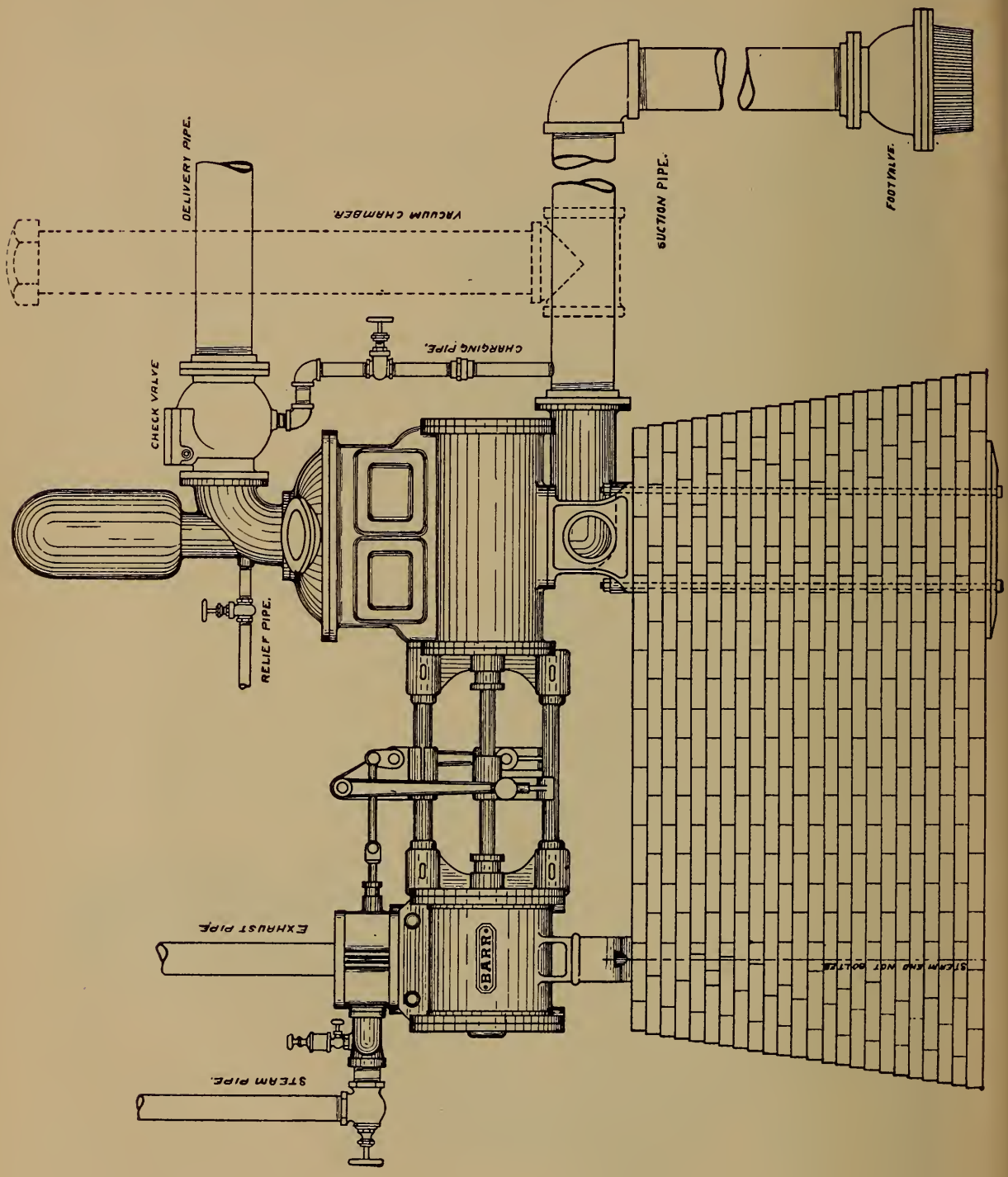
The preceding tables include duplex pumps of 5 to 12 inches stroke, and include almost every size needed in ordinary service, but many establishments require a much larger capacity than is tabulated in the foregoing pages, so that a selection of longer-stroke pumps is given below. In addition to these sizes we are prepared to build duplex pumps specially designed to meet any requirement.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.			Diameter of Pipes in Inches. (Subject to Change.)				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
14	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3	4	12	10	
16	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3	4	12	10	
18	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3½	5	12	10	
20	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3½	5	12	10	
16	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3	4	12	10	
18	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3½	5	12	10	
20	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3½	5	12	10	
22	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	4	6	12	10	
24	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	4	6	12	10	
18	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3½	5	14	12	
20	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3½	5	14	12	
22	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	4	6	14	12	
24	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	4	6	14	12	
26	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	5	7	14	12	
20	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	3½	5	14	12	
22	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	4	6	14	12	
24	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	4	6	14	12	
26	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	5	7	14	12	
28	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	5	7	14	12	
24	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	4	6	16	14	
26	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	5	7	16	14	
28	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	5	7	16	14	
30	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	6	8	16	14	
24	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	4	6	18	16	
26	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	5	7	18	16	
28	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	5	7	18	16	
32	20	24	32 64	40 to 60	2611 to 3917	3264	195,840	4,700,160	6	8	18	16	
36	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	8	10	18	16	
26	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	5	7	20	18	
28	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	5	7	20	18	
32	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	6	8	20	18	
36	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	8	10	20	18	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 14 x 12 x 18 for the first pump in the table, and similarly for any other size.


DELIVERY PIPE.
VACUUM CHAMBER.
SUCTION PIPE.
FOOT VALVE.
CHARGING PIPE.
CHECK VALVE
RELIEF PIPE.
EXHAUST PIPE
STEAM PIPE.
STEAM END NOT SHOWN
BARR

ERECTING AND PIPING A PUMP.

A general arrangement for the proper piping of a pump is shown on the opposite page, subject, of course, to such modifications as are necessary to adapt it to any particular location.

The pump is shown on a foundation; we recommend it as being more durable than placing it on a wooden floor, as the latter is liable to rot and may, in time, bring an undue strain upon the pipes, and thus tend directly to leaky joints. The water-end only requires to be bolted. Foundation drawings will be sent in advance of the shipment of a pump, so that the foundation may be in readiness when the pump arrives. Hard-burned brick, laid in cement-mortar, makes the best foundation.

The suction-pipe should be as short and direct as possible, and never less in diameter than the size given in the tables, increasing it for long lengths. A foot-valve should be used, and if a strainer is not attached to it there should be a strainer-box built around it to keep out floating matter, fish, etc. The check-valve should bolt directly against the flange of the delivery-elbow.

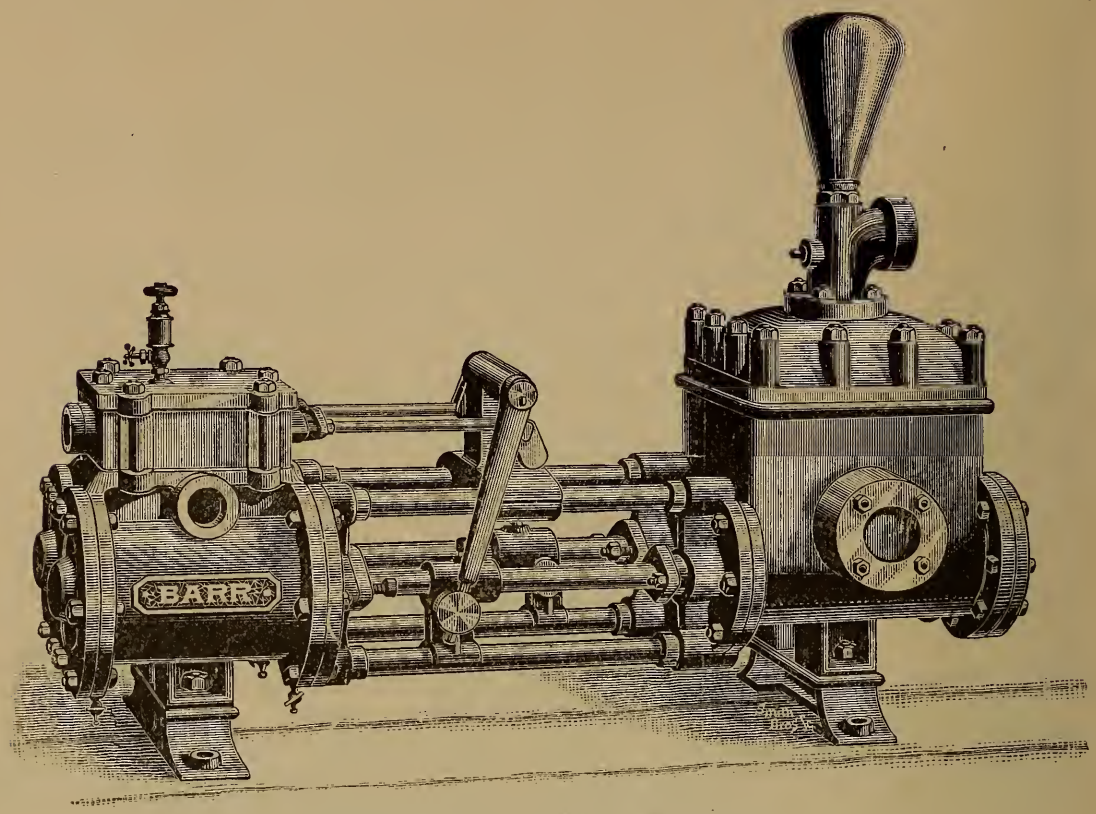
A charging-pipe should lead from the pressure-side of the check-valve into the suction-pipe. By opening the valve shown in the charging-pipe, the water from the reservoir or tank will flow into and fill the suction-pipe and the pump, thus expelling all the air.

A relief-valve and pipe is shown immediately back of the check-valve. This valve should be opened when filling the suction-pipe and pump with water, in order to allow the air to escape. The relief-pipe should lead to a drain or any place where the overflow would not cause inconvenience.

A vacuum-chamber is shown in dotted lines, together with a tee in the suction-pipe. This is not always necessary, but when it is it should be placed near the pump. If the suction-pipe goes into a deep well, and the distance from the well to the pump is short, the delivery-elbow may be changed to a tee, and the vacuum-chamber placed directly over the high lift.

The steam-pipe should be so arranged that the water of condensation, when the pump is not running, will drain back into the boiler. The exhaust may be led to any convenient point for escape into the atmosphere, or it may be used in steam-coils for heating. Whenever desired, it may be condensed by the apparatus illustrated on page 62.

Every pump is tested by us under steam before shipment, and the design, materials, and workmanship fully guaranteed.



DUPLEX BRINE-PUMPS.

These pumps are designed for use in connection with ice-making or cooling machinery. We can furnish either plunger or piston water-ends as may be preferred. When piston pumps are ordered the water-cylinders are always brass lined; the piston-rods, glands, valve-seats, and guards are made of hard brass to resist corrosive action. Brass pistons are arranged for the use of Tuck's or other similar packing.

Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	3	5	.15	100 to 200	30 to 60	45	2,700	¾	1	2	1½	
5	3¼	6	.21	100 to 175	42 to 74	58	3,480	1	1¼	2	1½	
5	4	6	.33	100 to 175	66 to 116	91	5,460	1	1¼	3	2	
6	4	8	.43	100 to 150	86 to 130	108	6,480	1	1½	3	2	
6	5	8	.68	100 to 150	136 to 204	170	10,200	1	1½	4	2½	
8	6	10	1.22	75 to 125	183 to 305	244	14,640	1½	2	4	3	
9	7	12	2.00	75 to 125	300 to 500	400	24,000	2	2½	6	5	
9	8	12	2.61	75 to 125	391 to 652	522	31,320	2	2½	6	5	
10	10	12	4.08	75 to 125	612 to 1020	816	48,960	2	2½	8	7	
12	12	12	5.87	75 to 125	880 to 1467	1174	70,440	2½	3	10	8	

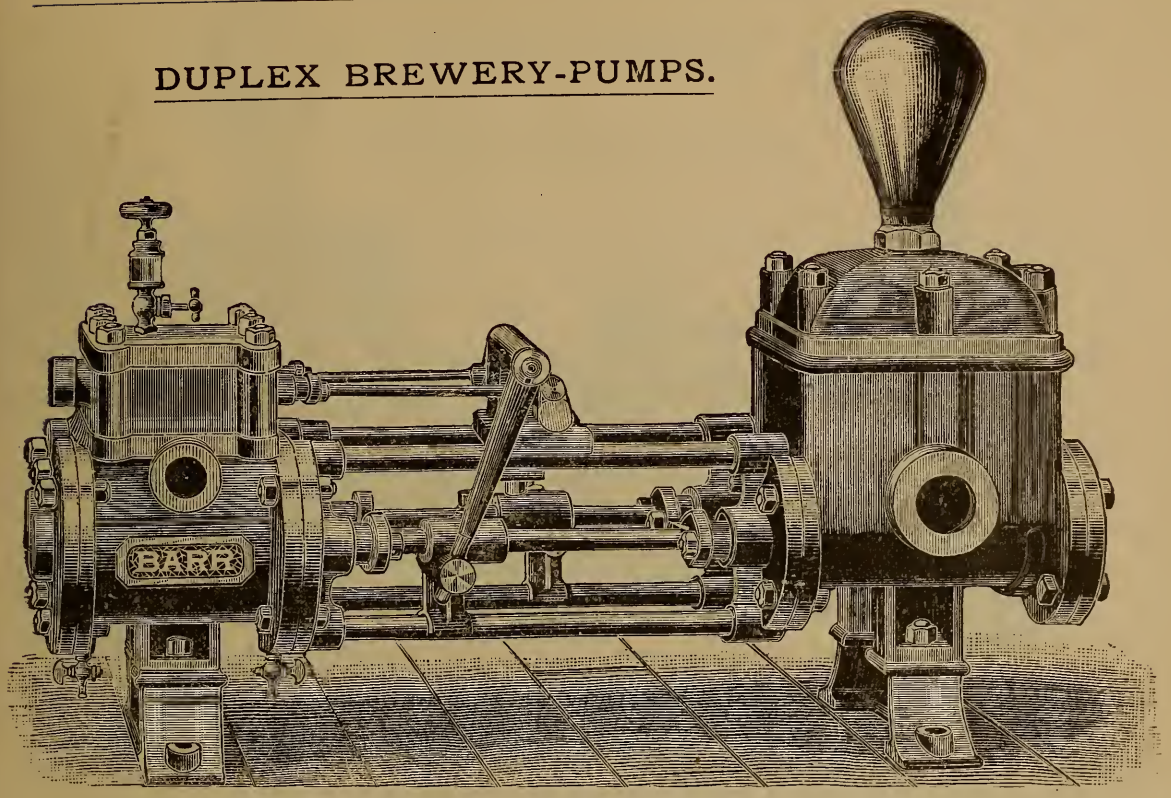
Other sizes and combinations made to order.

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke; thus, 4 x 3 x 5 for the first pump in the table, and similarly for any other size.

DUPLEX BREWERY-PUMPS.



Specially adapted for pumping hot or cold beer, mash, etc. These pumps are all of the packed-piston type, have brass piston-rods, brass-lined water-cylinders, pistons adapted for Tuck's or other similar packing. The valves are carefully selected for the work required of them. The water-ways and valve-areas are unusually large. In making comparisons it should be borne in mind that our duplex pumps have two steam-cylinders and two double-acting pistons, therefore double the capacity of a single pump of the same dimensions.

Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	3	5	.15	100 to 200	30 to 60	45	2,700	¾	1	2	1½	
5	3¼	6	.21	100 to 175	42 to 74	58	3,480	1	1¼	2	1½	
5	4	6	.33	100 to 175	66 to 116	91	5,460	1	1¼	3	2	
6	4	8	.43	100 to 150	86 to 130	108	6,480	1	1½	3	2	
6	5	8	.68	100 to 150	136 to 204	170	10,200	1	1½	4	2½	
8	6	10	1.22	75 to 125	183 to 305	244	14,640	1½	2	4	3	
9	7	12	2.00	75 to 125	300 to 500	400	24,000	2	2½	6	5	
9	8	12	2.61	75 to 125	391 to 652	522	31,320	2	2½	6	5	
10	10	12	4.08	75 to 125	612 to 1020	816	48,960	2	2½	8	7	
12	12	12	5.87	75 to 125	880 to 1467	1174	70,440	2½	3	10	8	

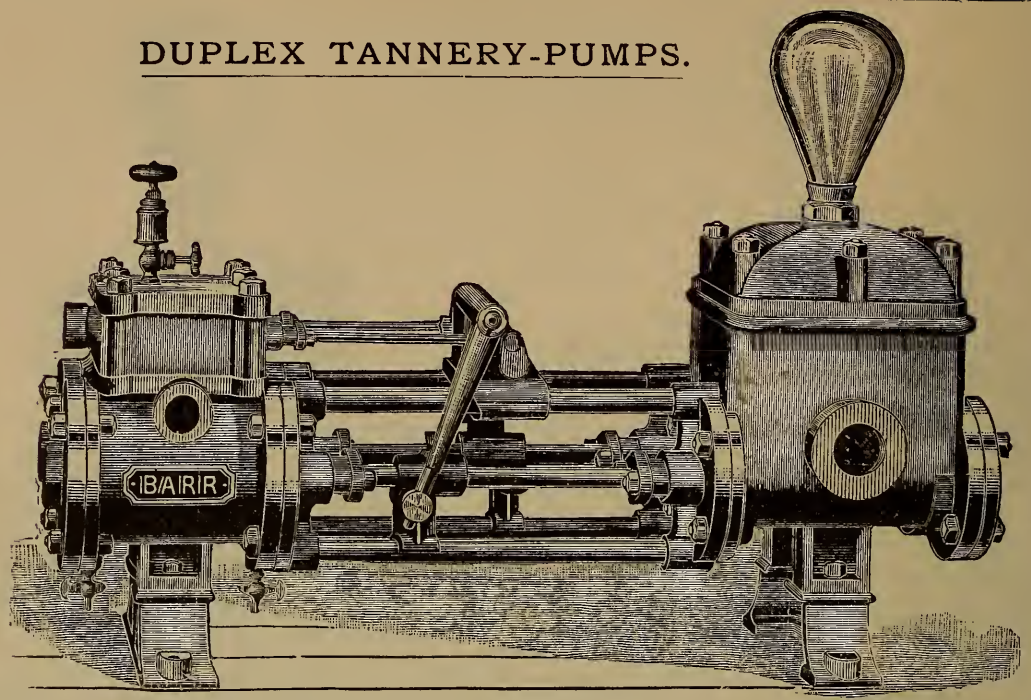
Other sizes and combinations made to order.

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke; thus, 4 x 3 x 5 for the first pump in the table, and similarly for any other size.

DUPLEX TANNERY-PUMPS.



Adapted equally well for either cold or hot liquors. The water-ends are of the piston pattern, brass lined, with brass piston-rods. The pistons are adapted for Tuck's or similar packing. Valves selected for the service required. The valve-openings are large to prevent clogging with particles of ground bark. In making comparisons it should be borne in mind that our duplex pumps have two steam-cylinders and two double-acting pistons, therefore double the capacity of a single pump of the same dimensions.

☞ For concentrated liquors or extracts we recommend water-ends constructed wholly of brass. Prices furnished upon application.

Diameter of Steam-Cylinders.	Diameter of Water-Cylinders.	Length of Stroke.	Gallons per Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	3	5	.15	100 to 200	30 to 60	45	2,700	¾	1	2	1½	
4	4	5	.27	100 to 200	54 to 108	81	4,860	¾	1	2	1½	
5	4	6	.33	100 to 175	66 to 115	91	5,460	1	1¼	3	2	
5	5	6	.51	100 to 175	102 to 178	140	8,400	1	1¼	3	2	
6	5	8	.68	100 to 150	136 to 204	170	10,200	1	1½	4	2½	
6	6	8	.98	100 to 150	196 to 294	245	14,700	1	1½	4	2½	
8	6	10	1.22	75 to 125	183 to 305	244	14,640	1½	2	4	3	
8	7	10	1.66	75 to 125	249 to 415	332	19,920	1½	2	5	4	
7	7	12	2.00	75 to 125	300 to 500	400	24,000	1½	2	6	5	
8	7	12	2.00	75 to 125	300 to 500	400	24,000	1½	2	6	5	
8	8	12	2.61	75 to 125	391 to 652	522	31,320	1½	2	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	2	2½	6	5	
10	10	12	4.08	75 to 125	612 to 1020	816	48,960	2	2½	8	7	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	2½	3	8	7	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-cylinders, and the length of stroke; thus, 4 x 3 x 5 for the first pump in the table, and similarly for any other size.

DUPLEX FIRE-PUMPS.

The selection of a fire-pump should be based upon no other consideration than that of merit. The several varieties of steam-pumps which have found popular favor in a variety of uses, have also competed sharply for favor in the matter of fire protection. The process of intelligent discrimination and selection has had the effect to bring out prominently the peculiar excellencies of the duplex steam-pump for this trying and important service, so that the superiority of the duplex valve-motion is now so fully recognized that, with scarcely any exception, the most careful and intelligent underwriters advocate, if they do not insist upon, this design of pump in all cases where they carry important fire risks.

LOCATION OF WATER-VALVES.

In examining the engravings it will be observed that the discharge- and suction-valves are located above the plungers; the pump can never, therefore, lose its charge. This distinctive feature of our duplex fire-pumps is of the highest importance, securing prompt action in emergency, and avoiding the danger of breakage that is incurred with pumps running dry.

STEAM-VALVE GEAR.

It is important that a fire-pump start promptly the moment the steam is turned on. This, in turn, makes it imperative that the valve-movement employed for the steam-end should be of the utmost simplicity, and have no concealed parts liable to derangement. There is nothing in our valve-gear which is not clearly shown on pages 12 and 36. It will be observed that the mechanism is of the simplest character. There are no steam-thrown valves, no springs, cams, supplemental pistons, concealed or intricate passages, or anything else that is liable to derangement or which, if out of order, cannot be adjusted without taking the pump apart. In fire-pumps of our construction the whole of the valve-gear is outside of the steam-end, in plain sight, and so simple in its detail that derangement is impossible.

HIGH PISTON SPEED.

A fire-pump must be able to attain a high piston speed, and maintain it without violent shock or concussion. It is important, therefore, that it be properly proportioned for the work, and that it have ample strength for this, the most exacting of any service. A common defect in trade pumps is that the valve-areas and water-passages are too small, the effect of which is, in practice, to cause excessive frictional resistance when running at moderate or high speeds; the steam-end, having scarcely any frictional resistance, drives the water-plungers faster than the water can flow into the pump; the result is a partially-filled water-cylinder and a corresponding shock when the plunger strikes the water.

CONTINUOUS STREAMS.

A continuous and perfectly uniform stream of water at a high velocity is the most effective in the event of a fire. No fire-pump yet produced surpasses the duplex in this respect. The reason for this is easily understood, and has reference mainly to the distribution of steam in the two steam-cylinders. The first effect upon the admission of steam is to push the steam-piston forward in the cylinder; the piston-rod being common to the steam-piston and the water-plunger, the latter moves forward in its stroke in unison with the steam-piston, at the same time expelling any water in front of it, and forming a vacuum behind it, which causes a flow of water into the pump-chamber from the central suction-chamber shown below the suction-valves (see illustrations on pages 12 and 14). To each piston-rod is attached a cross-head, which operates, through the medium of a lever and rock-shaft, the valve-rods on the opposite sides of the pump, so that, when one piston and plunger reaches the end of the stroke, the steam-valve on the opposite side has been reversed, and, in consequence, the operation of piston and plunger just described is also reversed. A certain amount of lost motion is given the valve-stem, which permits the piston and plunger on the one side to come to a state of rest before the other side reverses it. This momentary pause in the steam movement constitutes one of the valuable features in the duplex movement, because it permits the gentle seating of the suction- and delivery-valves, and has much to do with smooth running. This movement must not be confounded with the so-called duplex pump fitted with crank and fly-wheel, the cranks being set at right-angles; it is not the same thing at all, and there are no points in common between them. The inferiority of the latter as compared with

the former will be made apparent at a glance when the two movements are placed in comparison.

VACUUM-CHAMBERS.

It sometimes happens that the location of a fire-pump requires a suction-pipe of extreme length, and not infrequently several sharp bends are included in the pipe. In such a case a vacuum-chamber is found to add to the smoothness of the running, probably by preventing a water-hammer in the suction-pipe.

Whenever it is thought desirable to add a vacuum-chamber it should be placed near the pump. Its capacity will depend somewhat on the conditions attending the location of the fire-pump, which, if made known to us, we shall take pleasure in advising with reference to size and location of vacuum-chamber to secure the best results.

SIZE OF SUCTION-PIPE.

The diameters given in the table on page 37 for suction-pipes for fire-pumps are ample for pumping from a cistern or well located alongside of near the pump. If the suction-pipe be more than 50 feet long the size should be increased one inch in diameter, if more than 200 feet long an increase of two inches in diameter is recommended, and if over 500 feet long not less than three inches increase in diameter.

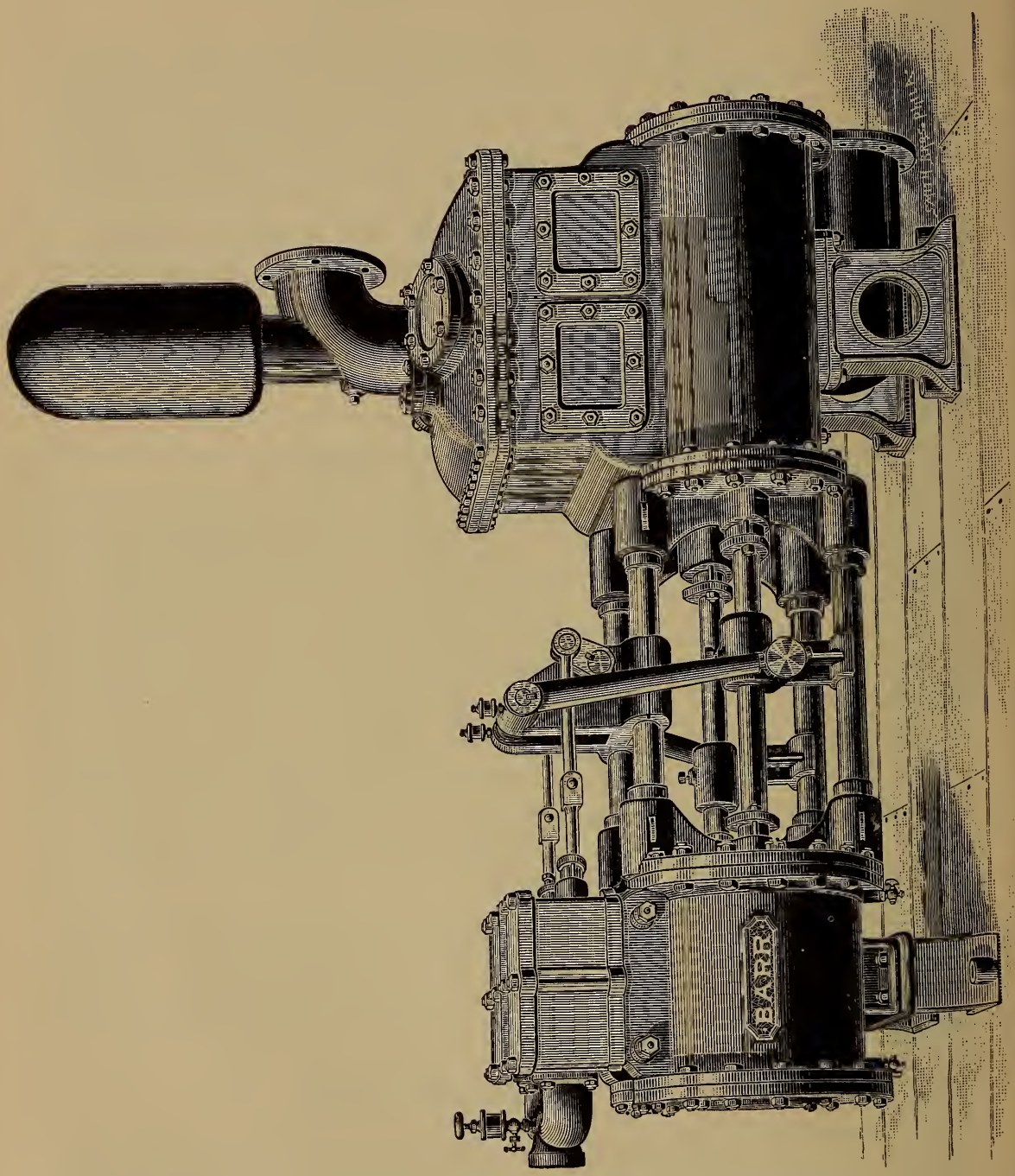
As there is nothing but gravity to compel the flow, it is possible to have more frictional resistance in the suction-pipe than can be quickly overcome by atmospheric pressure, and, in consequence, the pump is likely to "run away" from the water, and will have to be slowed-down to much less than its rated capacity.

A foot-valve should always be attached to the bottom of the suction-pipe, and, if the water-supply be had from a running stream, a strainer should also be attached to keep out floating matter, such as leaves, sticks, fish, etc.

SIZE OF DELIVERY-PIPE.

The size of delivery-openings, as given in the table for duplex fire-pumps, is ample for any ordinary requirement, and need not be enlarged for long lines or for heavy pressures; but for special or unusual service, we can make a larger delivery-elbow, of a diameter to meet the special needs of a customer. A delivery-tee can be attached to the force-chamber, having two or more openings, as illustrated on page 40.

DUPLEX FIRE-PUMP.



Size G 3, 18 x 10 x 12.

DUPLEX FIRE-PUMPS.

The engraving on the opposite page represents our standard design for duplex fire-pump, fitted with plunger and ring. These pumps are all double-acting and fitted with rubber valves, brass seats, guards, and springs suitable for pumping cold water. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod, respectively; this movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known, and as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke, consequently the pump can be started at any time with absolute certainty.

Letter and Number Denoting Size.	Nearest Ratio of Steam to Water.	Diameter of Steam-Cylinders.	Diameter of Water-Cylinders.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.*			Diameter of Pipes in Inches.				PRICE.
						80 Strokes per Minute.	100 Strokes per Minute.	120 Strokes per Minute.	Steam.	Exhaust.	Suction.	Discharge.	
A 3	3 to 1	8	5	10	0.85	136	170	204	1½	2	4	4	
A 4	4 to 1	8	4	10	0.54	86	108	129	1½	2	4	4	
A 5	5 to 1	8	3⅝	10	0.44	70	88	105	1½	2	4	4	
B 3	3 to 1	9	5¼	12	1.12	179	224	268	2	2½	5	4	
B 4	4 to 1	9	4½	12	.82	131	164	196	2	2½	5	4	
B 5	5 to 1	9	4	12	.65	104	130	156	2	2½	5	4	
C 3	3 to 1	10	6	12	1.47	235	294	342	2	2½	5	5	
C 4	4 to 1	10	5	12	1.02	163	204	244	2	2½	5	5	
C 5	5 to 1	10	4½	12	.82	131	164	196	2	2½	5	5	
D 3	3 to 1	12	7	12	2.00	320	400	480	2½	3	6	5	
D 4	4 to 1	12	6	12	1.47	235	294	342	2½	3	6	5	
D 5	5 to 1	12	5¼	12	1.12	179	224	268	2½	3	6	5	
E 3	3 to 1	14	8	12	2.61	417	522	626	3	4	7	6	
E 4	4 to 1	14	7	12	2.00	320	400	480	3	4	6	6	
E 5	5 to 1	14	6	12	1.47	235	294	342	3	4	6	6	
F 3	3 to 1	16	9	12	3.30	528	660	792	3	4	8	7	
F 4	4 to 1	16	8	12	2.61	417	522	626	3	4	6	6	
F 5	5 to 1	16	7	12	2.00	320	400	480	3	4	6	6	
G 3	3 to 1	18	10	12	4.08	652	816	979	3½	5	10	8	
G 4	4 to 1	18	9	12	3.30	528	660	792	3½	5	8	7	
G 5	5 to 1	18	8	12	2.61	417	522	626	3½	5	8	7	
H 3	3 to 1	20	12	12	5.87	939	1174	1408	3½	5	10	8	
H 4	4 to 1	20	10	12	4.08	652	816	979	3½	5	10	8	
H 5	5 to 1	20	9	12	3.30	528	660	792	3½	5	10	8	

* When selecting a fire-pump the size should be based on 100 strokes per minute; the additional capacity (as shown in the table) should be held in reserve.

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Prices quoted on application.

Sizes are usually designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 8 x 5 x 10 for the first pump in the table, or, the symbol A 3 may be used, which means an A fire-pump having a ratio of steam to water of 3 to 1, and similarly for any other size.

The above pumps can be fitted with brass plungers, rods, and stuffing-box glands for salt water at a slight advance on the above prices.

Special delivery fittings, including any number and arrangement of hose connections, valves, or other outlets will be supplied at cost, to suit the needs of a customer. See page 40.

FIRE-STREAMS WITH 1⅛-INCH SMOOTH NOZZLE.

(From Experiments of J. R. Freeman, 1888.)

Pressure at Nozzle in Pounds per Square Inch.	Maximum Limit Good Effective Fire-Stream, with Moderate Wind.		Gallons Discharged per Minute.	POUNDS PRESSURE AT HYDRANT OR FIRE-PUMP While stream is flowing, to maintain pressure at base of play-pipe, as per first column, through various lengths of 2½-inch ordinary Best Quality Rubber-Lined Hose.					
	Extreme Height.	Extreme Horizontal Distance.		50 Feet.	100 Feet.	200 Feet.	300 Feet.	400 Feet.	500 Feet.
	FEET.	FEET.		POUNDS.	POUNDS.	POUNDS.	POUNDS.	POUNDS.	POUNDS.
25	44	44	188	31	35	43	51	59	67
30	52	50	206	37	42	52	61	71	80
35	59	54	222	43	49	60	71	82	94
40	65	59	238	50	56	69	81	94	107
45	70	63	252	56	63	77	92	106	120
50	75	66	266	62	70	86	102	118	134
55	80	69	279	68	77	95	112	130	147
60	83	72	291	74	84	103	122	141	160
65	86	75	303	81	91	112	132	153	174
70	88	77	314	87	98	120	143	165	187
75	90	79	325	93	105	129	153	177	201
80	92	81	336	99	112	138	163	188	214
85	94	83	346	106	119	146	173	200	227
90	96	85	356	112	126	155	183	212	241
95	98	87	366	118	133	163	194	224	254
100	99	89	376	124	140	172	204	236	...

☞ The above is the pressure indicated by gauge at hydrant-head, or fire-pump delivery-elbow if hose is connected there, measured *while the stream is flowing*. The corresponding static reservoir-pressure, or fire-pump pressure, must be greater than the hydrant-pressure by an amount equal to the friction loss between the hydrant-head and pump or reservoir.

Eighty pounds per square inch is now considered the best hydrant-pressure for general use; 100 pounds per square inch should never be exceeded, except occasionally for very high buildings, or lengths of hose exceeding 300 feet.

Note.—By a good effective fire-stream is meant that, for a given pressure, the stream would enter through a window and barely strike the ceiling with force to scatter well, and which, at limit named, had not lost continuity of stream by dividing into a shower of spray, and which, at this limit, appeared to shoot nine-tenths of the whole body of water inside of a 15-inch circle, and three-fourths of it within a 10-inch circle, as nearly as could be judged by the eye.

DISCHARGE OF NOZZLES ATTACHED TO 100 FEET OF 2½-INCH HOSE.

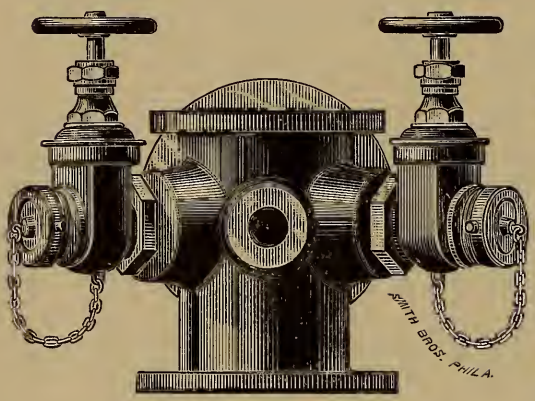
(From Experiments of J. R. Freeman, 1888.)

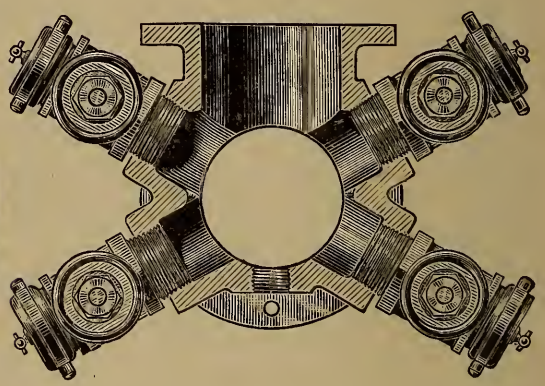
Hydrant-Pressure Indicated while Stream is Flowing. Pounds per Square Inch.	1⅜-Inch Smooth Nozzle. Gallons per Minute.			1¼-Inch Smooth Nozzle. Gallons per Minute.			1⅛-Inch Smooth Nozzle. Gallons per Minute.			1-Inch Smooth Nozzle. Gallons per Minute.			⅞-Inch Smooth Nozzle. Gallons per Minute.			¾-Inch Smooth Nozzle. Gallons per Minute.		
	Unlined Linen Hose.	Inferior Rubber-Lined Cotton "Mill Hose." Inside Rough.	Ordinary Best Quality Rubber-Lined Hose. Inside Smooth.	Unlined Linen Hose.	Inferior Rubber-Lined Cotton "Mill Hose." Inside Rough.	Ordinary Best Quality Rubber-Lined Hose. Inside Smooth.	Unlined Linen Hose.	Inferior Rubber-Lined Cotton "Mill Hose." Inside Rough.	Ordinary Best Quality Rubber-Lined Hose. Inside Smooth.	Unlined Linen Hose.	Inferior Rubber-Lined Cotton "Mill Hose." Inside Rough.	Ordinary Best Quality Rubber-Lined Hose. Inside Smooth.	Unlined Linen Hose.	Inferior Rubber-Lined Cotton "Mill Hose." Inside Rough.	Ordinary Best Quality Rubber-Lined Hose. Inside Smooth.	Unlined Linen Hose.	Inferior Rubber-Lined Cotton "Mill Hose." Inside Rough.	Ordinary Best Quality Rubber-Lined Hose. Inside Smooth.
5	75	79	93	70	72	82	62	64	71	54	55	59	44	45	47	34	34	35
10	107	111	131	98	102	116	88	91	100	76	78	83	63	63	66	48	49	50
15	131	136	160	121	125	143	108	111	123	93	95	102	76	77	81	59	60	61
20	151	157	185	139	144	164	125	128	142	107	110	118	88	89	94	68	69	71
25	169	176	207	155	161	184	139	143	158	120	122	132	99	100	105	76	77	79
30	185	192	226	170	176	202	152	156	173	132	134	144	108	110	115	84	84	87
35	200	208	245	184	190	218	165	169	188	142	145	156	117	119	124	90	91	93
40	214	222	262	197	204	233	176	181	201	152	155	167	125	127	133	97	97	100
45	226	236	278	209	216	247	187	192	213	161	165	177	132	134	141	103	103	106
50	239	249	293	220	228	260	197	202	224	170	174	186	139	142	148	108	109	112
55	251	261	307	231	239	273	207	212	235	178	182	195	146	148	155	113	114	117
60	261	273	320	241	250	285	216	222	245	186	190	204	153	155	162	118	119	122
65	272	284	333	251	260	296	225	231	255	194	198	213	159	161	169	123	124	127
70	282	294	346	261	270	307	233	240	265	201	205	221	165	167	176	128	129	132
75	292	304	358	270	279	319	241	248	275	208	212	228	171	173	182	132	133	137
80	301	314	370	278	288	329	249	256	284	215	219	236	177	179	188	137	138	142
85	311	324	382	287	297	339	257	264	293	222	226	243	182	185	193	141	142	146
90	320	333	393	295	306	349	264	272	301	228	233	250	188	190	199	145	146	150
95	329	342	403	303	314	358	272	279	309	234	239	257	192	195	204	149	150	154
100	337	351	414	311	322	368	279	287	317	240	245	264	197	200	210	153	154	158

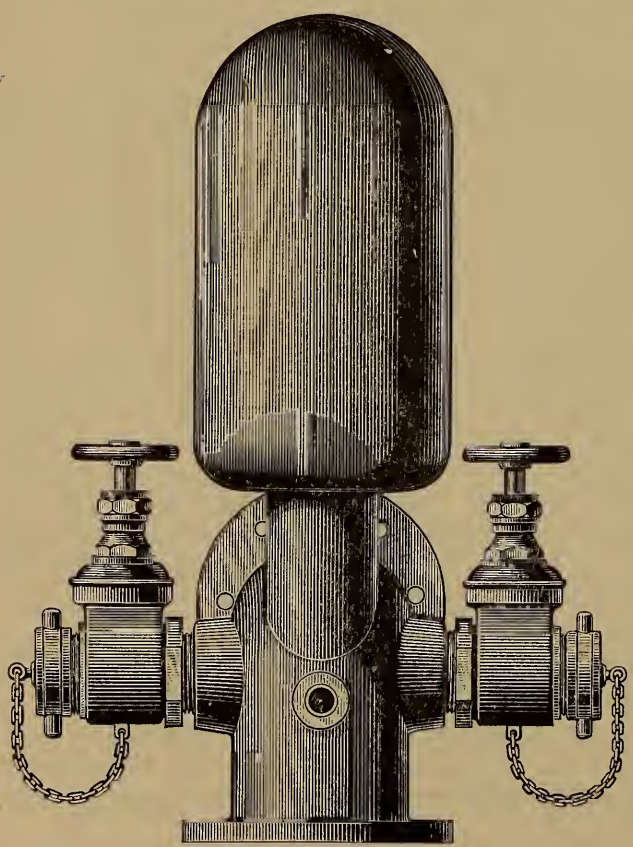
There is no advantage in having fire-streams of more than 100 pounds pressure per square inch. The number of 2½-inch hose-connections for supplying 1⅛-inch nozzles or fire-streams will depend upon the size of the fire-pump, but it is not recommended that more than four such connections be attached to the larger sizes given in the table of fire-pumps on page 37; it is better to have a less number of good streams than a greater number lacking in both volume and velocity.

FIRE-PUMP DELIVERY-TEES.

We can furnish delivery-tees having two, three, or four straight-way valves, with 2½-inch hose connections, as shown in the engraving below. This delivery-tee is located on top of the delivery-chamber of the fire-pump and below the air-chamber. The discharge will be of the same diameter as given in the table on page 37.







In addition to the above, we can fit the regular delivery-elbow of a fire-pump with one or two gate-valves, as shown in the accompanying illustration. The delivery-elbow is of the same pattern as that ordinarily furnished with our fire-pumps, the only difference being that the projections shown on each side are fitted with gate-valves suited for 2½-inch hose.

In the event that the designs shown on this page do not meet the requirements of a customer, we are prepared to make any other design to order.

THE UNDERWRITER FIRE-PUMP.

The Underwriter Pump is the name adopted by the Associated Factory Mutual Insurance Companies, to designate a Steam Fire-Pump built in accordance with specifications prepared by their engineer, and adopted at the monthly conference of the Associated Companies, June 15, 1891.

Fire-Pumps are expected to run at much higher speeds than pumps for boiler feeding or other regular water supply. Experience shows that, under ordinary circumstances, fire-pumps do not get any such care as a steam-engine or other machine on which the product of the factory depends.

A fire-pump should be proof against disabling by rust after weeks of disuse; it should be possible to instantly start a fire-pump and run it at full speed, even by a man who is excited and perhaps unskilful.

Steam-Cylinders. The strength of steam-cylinders shall be such as to use steam of 100 pounds pressure, with ample thickness in the steam-cylinders and on the valve-face for reboring and refitting.

The Steam-Ports are constructed exactly in accordance with the Underwriters' circular, and, in addition, a supplementary port leading from each end of each steam-cylinder into the exhaust port; each one of these ports being fitted with a cushion-valve, more fully described below. The steam clearance space has been reduced to the smallest amount consistent with safety.

Cushion-Valves will be provided, one valve at each end of each steam-cylinder. These valves can be adjusted whilst the pump is in operation, and each valve will be provided with a brass disc, properly lettered, so that the valve can be adjusted either to cushion or to length of stroke, as may be required.

Stroke-Gauge. A gauge will be provided each side of the pump, securely attached to the tie-bars. A suitable pointer will be attached to the cross-head, so that the stroke of the pistons can be ascertained at any time the pump is in motion.

A Steam-Pressure Gauge will be fitted to the steam-pipe inside of the throttle-valve; it will be properly piped and supplied with cock and lever-handle.

A Sight-Feed Lubricator will be furnished, including valves for shutting off the steam when not in use.

Drip-Cocks, with lever-handles, will be provided each end of each steam-cylinder for drainage.

The Water-End shall be of sufficient thickness to admit of closing all valves on the water-outlet pipes, while the steam-valve is wide open, with a steam-pressure of 80 pounds, and each fire-pump will be so tested before shipment from our works.

Plungers. The pumps are all of the inside plunger pattern, the plungers being made of a bronze composition of copper and tin, fitting into plunger-rings of the same material but of different proportions, each mixture to be such as shall insure the best wearing qualities.

Brass Fitting. All fire-pumps made by us are brass fitted throughout,—that is to say, the plungers and plunger-rings will be made of hard bronze, composed entirely of new copper and tin, and not containing any zinc in its composition. The piston-rods will be made of manganese or Tobin bronze, guaranteed to be equal strength of open hearth steel. The stuffing-boxes in the water-end and steam-end will be provided with bronze bushings, so that no part of the rod shall at any time come in contact with iron surfaces. The valve-rods and stuffing-boxes will be similarly made and fitted. The glands will be made of bronze.

Suction-Valves. The net areas of ports in suction-valves for each end of each plunger are to be, according to the Underwriters' circular, not less than 56 per cent. of the plunger area. All of the fire-pumps made by us have valve areas much larger than the above. *We have adhered to the recommendation of the Underwriters' engineer, to put in a larger number of small valves instead of a few large valves.*

Delivery-Valves. The Underwriters' specification states that the force-valves need have but two-thirds the total port areas specified for the suction-valves. The delivery-valves in any of the fire-pumps designed by us have more than double the areas specified above.

Location of Valves. *The discharge and suction-valves in our fire-pumps are above the plungers;* the pump can never, therefore, lose its charge. This distinctive feature of our duplex pumps is of the highest value to the user, securing prompt action in emergency, and avoiding the danger of breakage that is incurred with pumps running dry.

Construction of Valves. The valve-seats are screwed in; the

valve-stem or guard and the valve-seat are cast together in one piece. The valve is protected by a brass plate. The spring is of cylindrical form instead of conical, and thus brings a uniform tension upon its entire length; it bears upon the brass plate at the bottom, and is held and guided by a brass nut at the top; this nut is secured to the stem by a taper-thread and also by a split-pin. This construction is an absolute safeguard against the valve getting adrift in the water-end.

Pressure-Gauges will be provided each pump, fitted with ¼-inch cock with lever-handle, and so piped that the water-pressure can be ascertained at a glance.

Drip-Cocks, with lever-handles, will be provided each end of each water-cylinder for drainage. These cocks to be not less than ⅜-inch diameter of opening. A similar drain-cock will be provided for drawing off the water above the upper valve-deck. A ¼-inch air-cock with lever-handle will be attached to the delivery-chamber.

Capacity-Plate. Each fire-pump will be provided with an enamelled plate, which will bear conspicuously a statement of the capacity of the pump. This plate will be secured to the air-chamber.

A Safety- or Relief-Valve will be furnished and attached to the delivery side of the pump. This valve will be set at a working pressure of 100 pounds per square inch, and will be of a design or manufacture subject to the approval of the Associated Mutual Companies. Each valve to be provided with a hand-wheel, with proper lettering to indicate in which direction the hand-wheel is to be turned to either increase or decrease the pressure. The size of each relief-valve is given in the table of general dimensions.

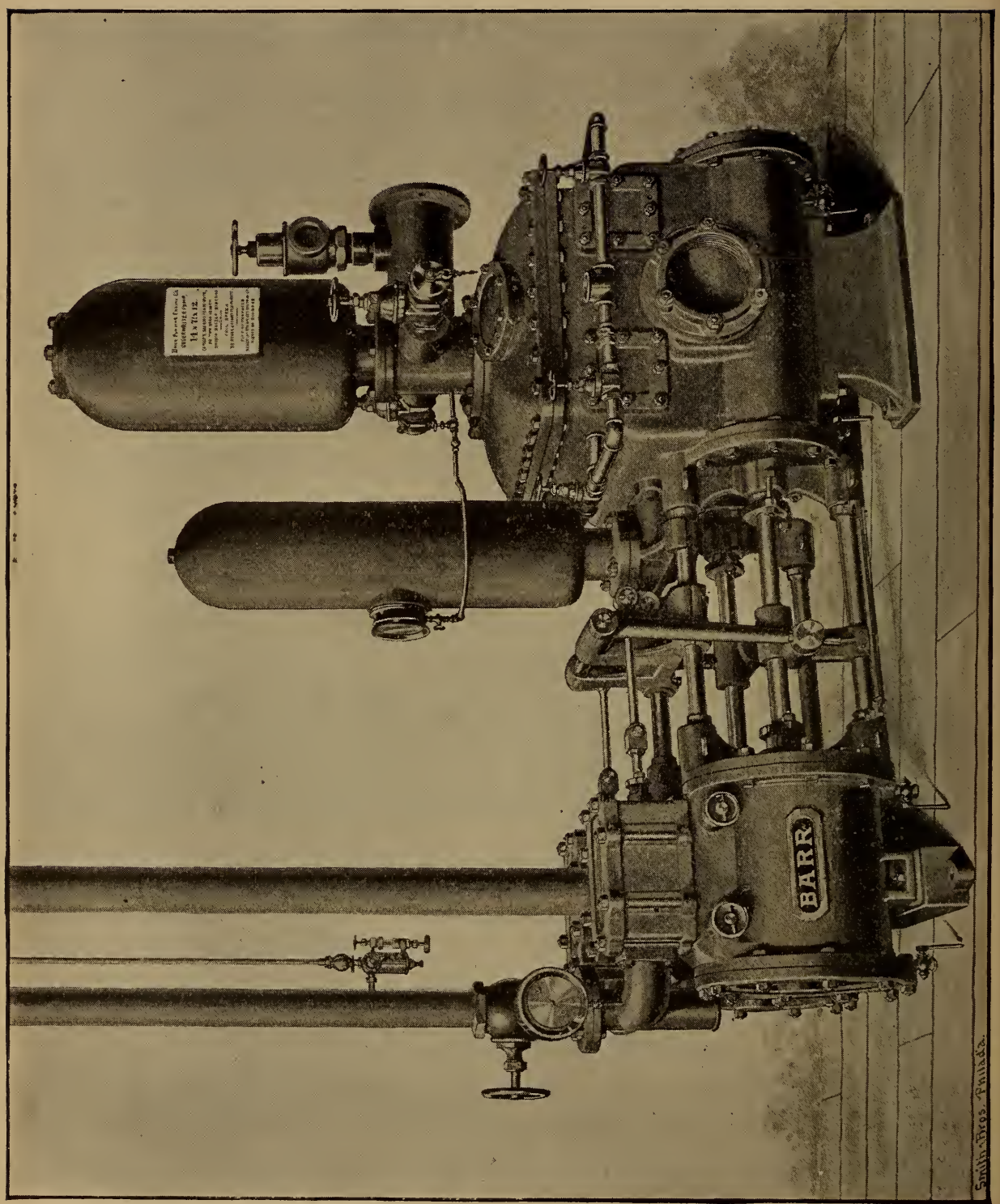
Vacuum-Chamber. Each pump will be fitted with a vacuum-chamber, permanently attached to the pump, and of the capacity given in the table.

An Air-Chamber will be fitted to each delivery-chamber, and will be of the capacity given in the table.

Priming-Pipes. Each pump will be fitted with a priming apparatus, so that each end of each water-cylinder can be primed from any source of supply convenient to the pump.

Hose-Connections. Each fire-pump will be fitted with 2½-inch straightway hose-valves, attached to the delivery-tee, between the delivery-chamber and the air-chamber.

UNDERWRITER FIRE-PUMP.



Size, 14 x 7¼ x 12.

FOUR SIZES OF UNDERWRITER PUMPS ARE SPECIFIED.

No. 1.	Capacity,	300	gallons	per	minute,	for	1	fire	stream.
No. 2.	"	500	"	"	"	"	2	"	"
No. 3.	"	750	"	"	"	"	3	"	"
No. 4.	"	1000	"	"	"	"	4	"	"

All fire-pumps to be adapted for 2½-inch hose-couplings.

250 gallons per minute is the Underwriters' allowance for a good 1⅛-inches (smooth nozzle) fire-stream.

No. 1 Fire-Pump is fitted with steam-cylinders 12 inches diameter, water-plungers, 6 inches diameter, all of 12 inches stroke. This water-end has a displacement of 1.47 gallons for one stroke of one plunger, so that 352 gallons displacement is had when making 60 revolutions per minute.*

This pump is fitted for one line of 2½-inch hose.

Too small for a fire-pump, except as an auxiliary.

Pipes will be as follows: steam, 2½ inches; exhaust, 3 inches; suction, 6 inches; delivery, 5 inches. Price, $

No. 2 Fire-Pump is fitted with steam-cylinders 14 inches diameter, water-plungers, 7¼ inches diameter, all of 12 inches stroke. The water-end has a displacement of 2.14 gallons for one stroke of one plunger, so that 599 gallons displacement is had when making 70 revolutions per minute.*

This pump has the Underwriters' rating of 500 gallons per minute, and is fitted for two lines of 2½-inch hose.

This is the ordinary size for small mills.

Pipes will be as follows: steam, 3 inches; exhaust, 4 inches; suction, 8 inches; delivery, 6 inches. Price, $

No. 3 Fire-Pump is fitted with steam-cylinders 16 inches diameter, water-plungers, 9 inches diameter, all of 12 inches stroke. This water-end has a displacement of 3.3 gallons for one stroke of one plunger, so that 924 gallons displacement is had when making 70 revolutions per minute.*

* By revolution is meant one complete circuit of the motion of the reciprocating parts of the pump.

This pump has the Underwriters' rating of 750 gallons per minute, and is fitted for three lines of 2½-inch hose.

This is the ordinary size for general use.

Pipes will be as follows: steam, 3½ inches; exhaust, 4 inches; suction, 10 inches; delivery, 7 inches. Price, $

No. 4 Fire-Pump is fitted with steam-cylinders 18 inches diameter, water-plungers, 10 inches diameter, all of 12 inches stroke. This water-end has a displacement of 4.08 gallons for one stroke of one plunger, so that 1142 gallons displacement is had when making 70 revolutions per minute.*

This pump has the Underwriters' rating at 1000 gallons per minute, and is fitted for four lines of 2½-inch hose.

This is the size for large factories.

Pipes will be as follows: steam, 4 inches; exhaust, 5 inches; suction, 12 inches; delivery, 8 inches. Price, $

Although we make no guaranty as to ability to exceed the requirements and rating of the Underwriters' specification, we would state that tests which we have made show that it is entirely safe and practicable to run a pump of this special design at a speed such that it will deliver a much larger quantity in an emergency, or for an hour or so during a fire; nevertheless, we advise that this excess of capacity be regarded as a margin against deterioration as the pump grows old, and would not advise planning of works on any other basis than that above.

The following necessary fittings, heretofore charged for as extras, are included in the price, and regularly furnished as a part of this pump, viz.:

A capacity-plate is added.
A stroke-gauge is added.
A vacuum-chamber is added.
Two best quality pressure-gauges.
A water-relief valve of large capacity.
A set of brass priming-pipes and valves.
From two to four Chapman hose-valves.

The Underwriter Pumps made by us are from entirely new designs and patterns made in exact accordance with the circular issued by the Associated Factory Mutual Insurance Companies, and are not the ordinary trade pumps with the special fittings attached.

* By revolution is meant one complete circuit of the motion of the reciprocating parts of the pump.

COMBINED DUPLEX PUMP AND BOILER.

The combination shown on page 48 is one in which the pump and boiler are so arranged as to make a compact and self-contained pumping plant.

The pump is our regular duplex type, the water-end being fitted with either pistons or plungers, as may be selected for the work. A heavy cast-iron base-plate is provided, to which the pump is securely fastened. This base-plate extends under the boiler, and is the means by which the pump and the boiler are connected so as to form the combined machine.

The boiler is of the most approved vertical type, the shell being of either the best quality of flange iron or of steel, the latter being carefully selected and tested before working, the standard tensile strength being 60,000 pounds per square inch, with an elastic limit of one-half that amount, test specimens developing an average elongation of 20 per cent. in eight inches, with a reduction of area of 40 to 50 per cent.

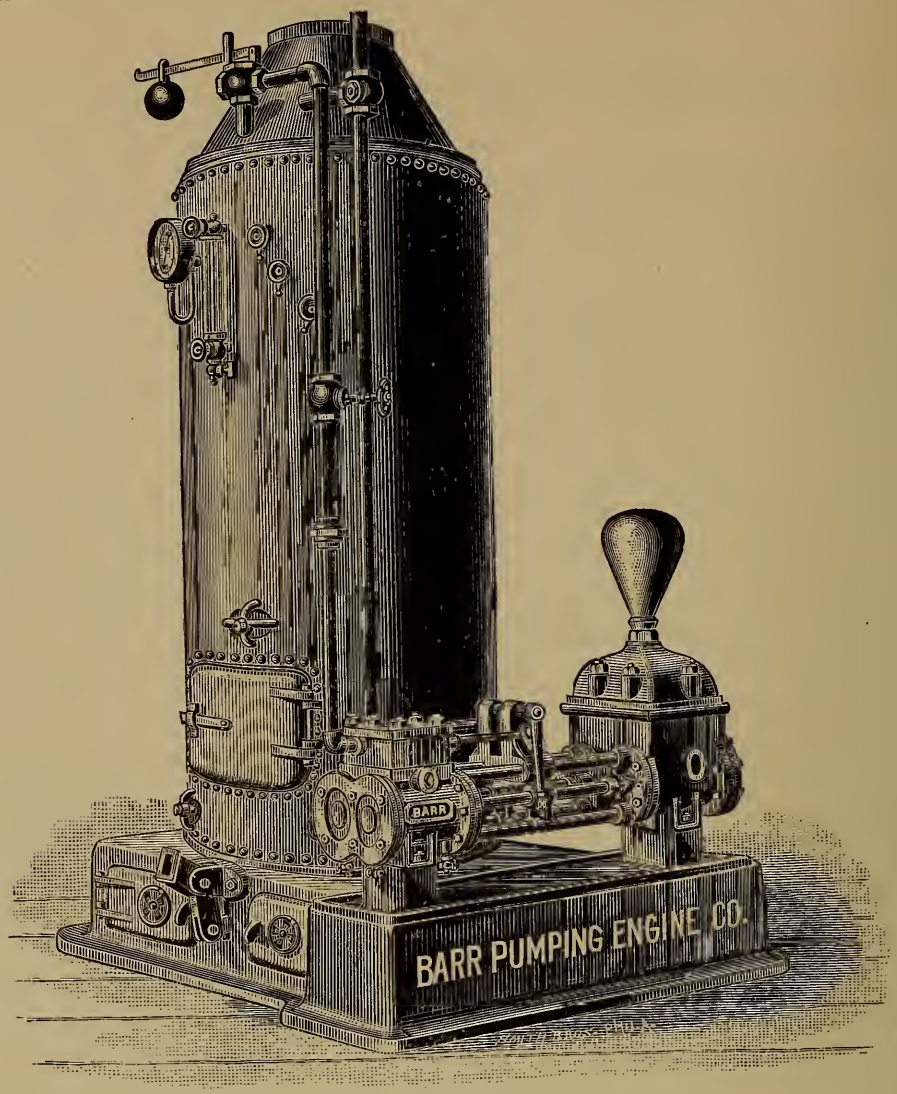
The riveting receives special attention; the quality of material, being of prime importance, is always under supervision and test. The holes are carefully spaced and reamed to secure perfect openings for the rivets. Whenever practicable, the rivets are machine driven, at a pressure of 30 to 50 tons, which is sufficient to force the metal of the rivet to completely fill the rivet-holes throughout its entire length before the head is formed. The tubes are lap-welded charcoal iron of the best manufacture, and carefully expanded in bored and reamed holes. The caulking is done by the Connery method, with round-nosed tools, on carefully-bevelled plates which are prepared before punching and rolling.

These boilers are carefully proportioned for the work, and are adapted for a working-pressure of 100 pounds per square inch.

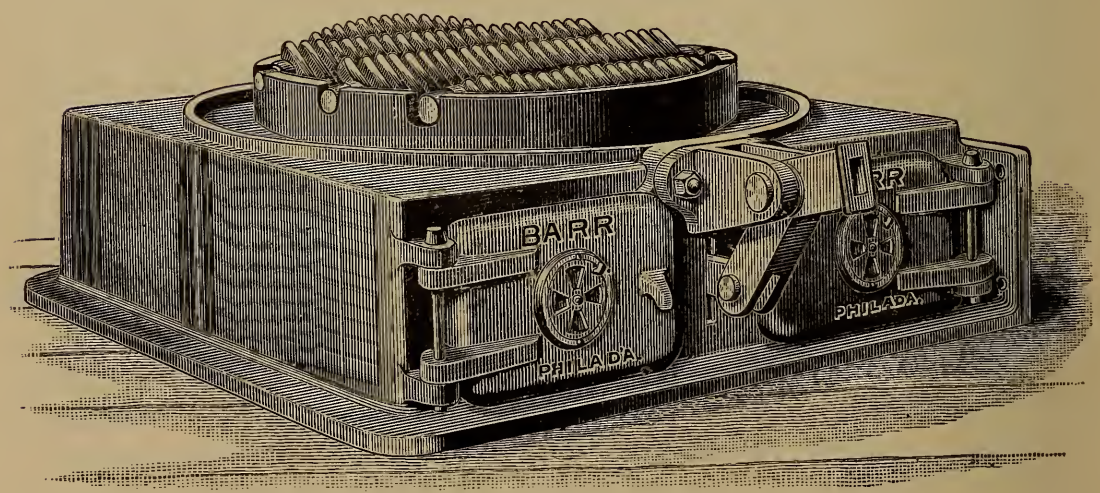
The fittings furnished with each outfit comprise an auxiliary boiler-feed, safety-valve, steam-gauge, water-gauge, gauge-cocks, all the necessary steam-, exhaust-, and feed-water-pipes and valves. A three-way exhaust-cock is supplied, with blast-nozzle. A smoke-hood is furnished, but no smoke-stack.

The extreme simplicity of our combined pump and boiler is such that any person of ordinary intelligence can manage it. It is designed for the use of contractors, railway pumping-stations, small water-works, country residences, sea-side and mountain resorts, hotels, tanneries, quarries, brick-yards, factories of all kinds.

These pumps and boilers will be combined as given in the annexed tables, or with any other combination that may be desired.



Size, 5 x 3¼ x 6.



Boiler-Base, with Shaking-Grate.

COMBINED DUPLEX STEAM-PUMP AND BOILER.

Self-contained and mounted on a heavy cast-iron base-plate. Specially adapted for railroad water-stations, quarries, contractors, sea-side hotels, country residences, manufacturing establishments, etc. Valves will be furnished suitable for cold water, hot water, alkaline liquor, or acidulated water, suited to the needs of the customer. This pump is noiseless in its operation, has plain, flat slide-valves driven by a positive movement outside of the steam-chest and in plain view at all times; as our valve-motion has no dead centre, the pump is always in readiness for service. The delivery of water is at all times constant and uniform. The speed can be regulated to the utmost nicety for any required service.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				Price Complete.	DIMENSIONS OF BOILER.			
					Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.		Diameter of Shell.	Height of Shell.	Number of Tubes.	Length of Tubes.
REGULAR PATTERN FOR GENERAL SERVICE.															
3	2	4	.05	100 to 200	15	900	½	¾	1	¾		24	48	31-2	24
4	2	5	.068	100 to 200	20	1,200	¾	1	1¼	1		24	60	31-2	36
4	2½	5	.10	100 to 200	30	1,800	¾	1	1½	1¼		24	60	31-2	36
5	2½	6	.12	100 to 175	33	1,980	1	1¼	1½	1¼		30	60	55-2	33
5	3¼	6	.21	100 to 175	58	3,480	1	1¼	2	1½		30	60	55-2	33
6	3	8	.24	100 to 150	60	3,600	1	1½	2	1½		30	72	55-2	45
6	4	8	.43	100 to 150	108	6,480	1	1½	3	2		30	72	55-2	45
8	4	10	.54	75 to 125	108	6,480	1½	2	3	2		36	84	77-2	57
8	5	10	.85	75 to 125	170	10,200	1½	2	4	3		36	84	77-2	57
LOW SERVICE OR TANK PUMPS.															
4	3	5	.15	100 to 200	45	2,700	¾	1	2	1½		24	60	31-2	36
4	4	5	.27	100 to 200	81	4,860	¾	1	2½	1½		24	60	31-2	36
5	4	6	.33	100 to 175	91	5,400	1	1¼	3	2		30	60	55-2	33
5	5	6	.51	100 to 175	140	8,400	1	1¼	3½	2		30	60	55-2	33
6	5	8	.68	100 to 150	170	10,200	1	1½	4	2½		30	72	55-2	45
6	6	8	.98	100 to 150	245	14,700	1	1½	4	3		30	72	55-2	45
8	6	10	1.22	75 to 125	244	14,640	1½	2	4	3		36	84	77-2	57
8	7	10	1.66	75 to 125	332	19,920	1½	2	5	4		36	84	77-2	57

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

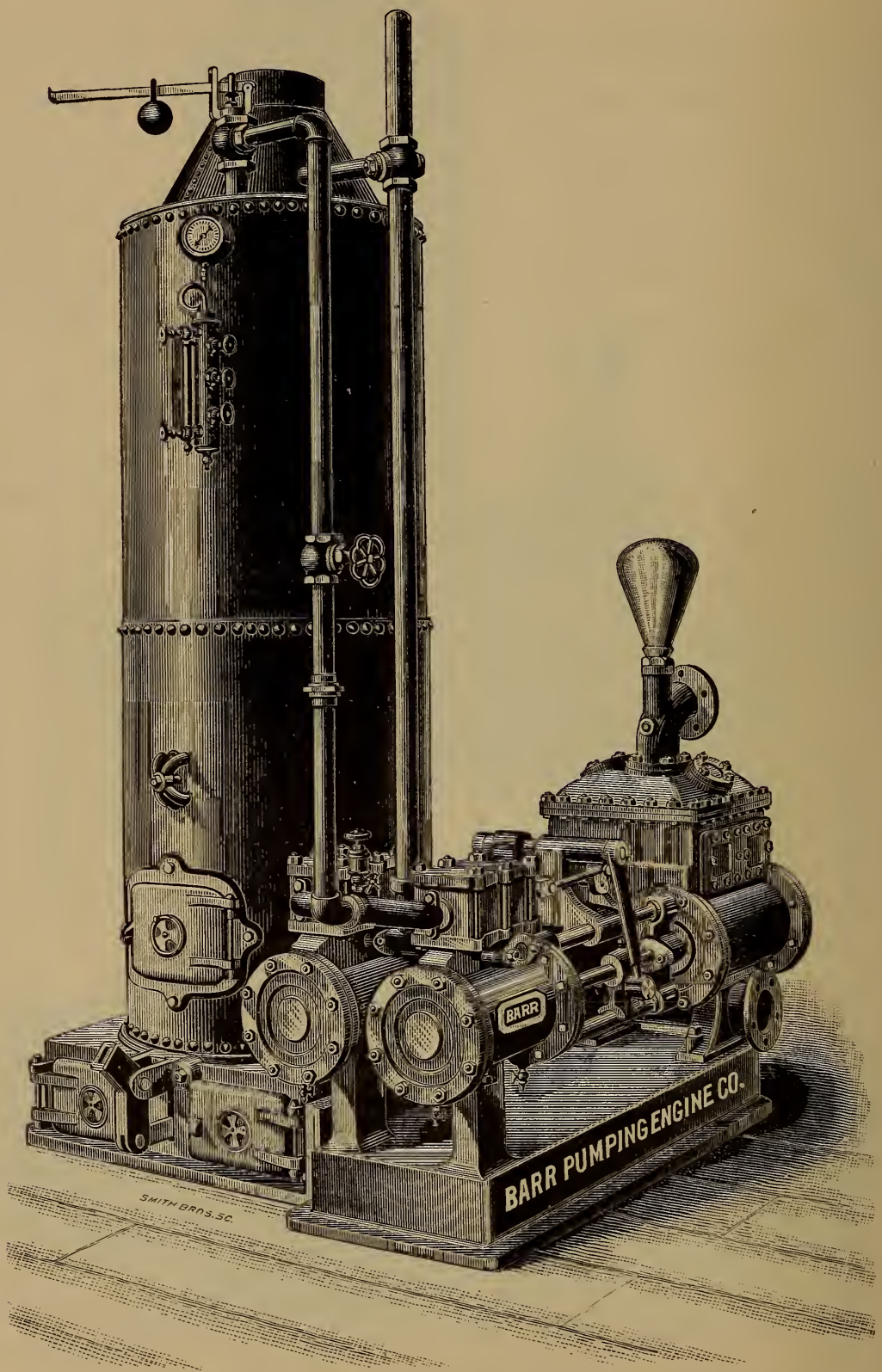
Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 3 x 2 x 4 for the first pump in the table, and similarly for any other size.

Regular Pattern Pumps for general service may be used at any pressure not exceeding 150 pounds per square inch.

Low-Service Pumps are intended for pressures from 25 to 50 pounds per square inch.

COMBINED DUPLEX PUMP AND BOILER.



COMBINED DUPLEX STEAM-PUMP AND BOILER.

These pumps will be furnished with either rubber or metal valves, and fitted with double-acting plungers, working in a solid brass ring. When fitted with packed pistons the water-cylinders are lined with brass. The water-ways and valve-areas are unusually large. Nothing has been omitted in design, material, or workmanship to make these pumps the foremost in the market.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				Price Complete.	DIMENSIONS OF BOILER.			
					Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.		Diameter of Shell.	Height of Shell.	Number of Tubes.	Length of Tubes.
REGULAR PATTERN FOR GENERAL SERVICE.															
8	6	12	1.47	75 to 125	294	17,640	1½	2	5	4		42	87	109-2	60
9	6	12	1.47	75 to 125	294	17,640	2	2½	5	4		42	87	109-2	60
10	6	12	1.47	75 to 125	294	17,640	2	2½	5	4		42	87	109-2	60
9	7	12	2.00	75 to 125	400	24,000	2	2½	6	5		42	99	109-2	72
10	7	12	2.00	75 to 125	400	24,000	2	2½	6	5		42	99	109-2	72
12	7	12	2.00	75 to 125	400	24,000	2½	3	6	5		42	99	109-2	72
10	8	12	2.61	75 to 125	522	31,320	2½	3	6	5		48	102	149-2	72
12	8	12	2 61	75 to 125	522	31,320	2½	3	6	5		48	102	149-2	72
14	8	12	2.61	75 to 125	522	31,320	3	4	6	5		48	102	149-2	72
12	10	12	4.08	75 to 125	816	48,960	2½	3	8	7		54	108	201-2	78
14	10	12	4.08	75 to 125	816	48,960	3	4	8	7		54	108	201-2	78
16	10	12	4.08	75 to 125	816	48,960	3	4	8	7		54	108	201-2	78
LOW SERVICE OR TANK PUMPS.															
6	6	12	1.47	75 to 125	294	17,640	1	1½	5	4		36	84	77-2	57
7	6	12	1.47	75 to 125	294	17,640	1¼	2	5	4		36	84	77-2	57
6	7	12	2.00	75 to 125	400	24,000	1	1½	6	5		36	84	77-2	57
7	7	12	2.00	75 to 125	400	24,000	1¼	2	6	5		36	84	77-2	57
8	7	12	2.00	75 to 125	400	24,000	1½	2	6	5		36	84	77-2	57
6	8	12	2.61	75 to 125	522	31,320	1	1½	6	5		36	96	77-2	69
7	8	12	2.61	75 to 125	522	31,320	1¼	2	6	5		36	96	77-2	69
8	8	12	2.61	75 to 125	522	31,320	1½	2	6	5		36	96	77-2	69
9	8	12	2.61	75 to 125	522	31,320	2	2½	6	5		36	96	77-2	69
8	10	12	4.08	75 to 125	816	48,960	1½	2	8	7		42	87	109-2	60
9	10	12	4.08	75 to 125	816	48,960	2	2½	8	7		42	87	109-2	60
10	10	12	4.08	75 to 125	816	48,960	2½	3	8	7		42	87	109-2	60

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 8 x 6 x 12 for the first pump in the table, and similarly for any other size.

Regular Pattern Pumps may be used at any pressure not exceeding 150 pounds per square inch.

Low-Service Pumps are intended for water-pressures from 25 to 50 pounds per square inch.

COMPOUND STEAM-PUMPS.

The engraving on page 54 represents one of several of our designs for compound pumping-engines. It is well known that ordinary direct-acting steam-pumps are not economical in the use of steam. Where a saving in fuel is a matter of any consequence, compounding is recommended. In the design referred to, the high- and low-pressure cylinders are placed end to end, thus enabling both pistons to be attached to the same piston-rod. This detail is fully shown in the illustration below.

THE VALVE-GEAR.

The valve-gear is in no respect different from that employed in our standard designs, the distribution of steam being effected in precisely the same manner. Steam is admitted to the smaller or high-pressure cylinder, forcing the smaller piston forward, with a pressure the same as that in the high-pressure steam-chest, until the end of the stroke is reached; this steam, instead of being exhausted into the atmosphere, is carried into the steam-chest of the larger or low-pressure cylinder, it is there utilized in forcing the larger piston back to its original position in the return stroke. The larger area of the low-pressure cylinder, having only the pressure of the atmosphere as a resistance, corresponds in its effect to the action of a cut-off on a single cylinder-crank and fly-wheel engine, but without sacrificing any of the valuable features of the duplex method of handling water.

ECONOMY IN COMPOUNDING.

The advantages accruing from the use of high-pressure steam are now not only fully understood, but extensively practised. Non-condensing compound steam-ends are very effective and economical when from eighty to one hundred pounds steam pressure is used; the gain over the ordinary direct-acting cylinders being from 25 to 40 per cent., depending on the initial pressure and the ratio of expansion. Non-condensing steam-ends are not recommended for pressures below fifty pounds, as we do not believe a sufficient gain can be had to pay for the increased cost of the machinery.

HIGH-SERVICE ATTACHMENT.

We are prepared to furnish any size of compound steam-ends with a high-service attachment, by which the steam is admitted at full boiler-pressure in the low-pressure cylinders, thereby increasing the steam-power of the pump to double its ordinary rating. This attachment has been found very useful in elevator-pumps for special loads, for water-works pumps when needing additional power for fire service, and in a variety of other cases where additional power was required for a short time.

STEAM-JACKETS.

Whenever desired, we can furnish duplex-pumps, either simple or compound, in which the steam-cylinders will be fitted with steam-jackets. These jacketed-cylinders are designed with reference to proper circulation and drainage.

The steam-connection for jacketed-cylinders should lead from the boiler direct, or, if this is not convenient, then from some point above the throttle-valve rather than from the steam-chest, the object being to get the advantage of the higher temperature due to the greater steam-pressure, and thus increase the efficiency of the jacket surrounding the steam-cylinder; the effect desired being to keep the inner cylinder or lining at a temperature higher than that of the steam doing the work inside of the cylinder.

LAGGING AND EXTRA FINISH.

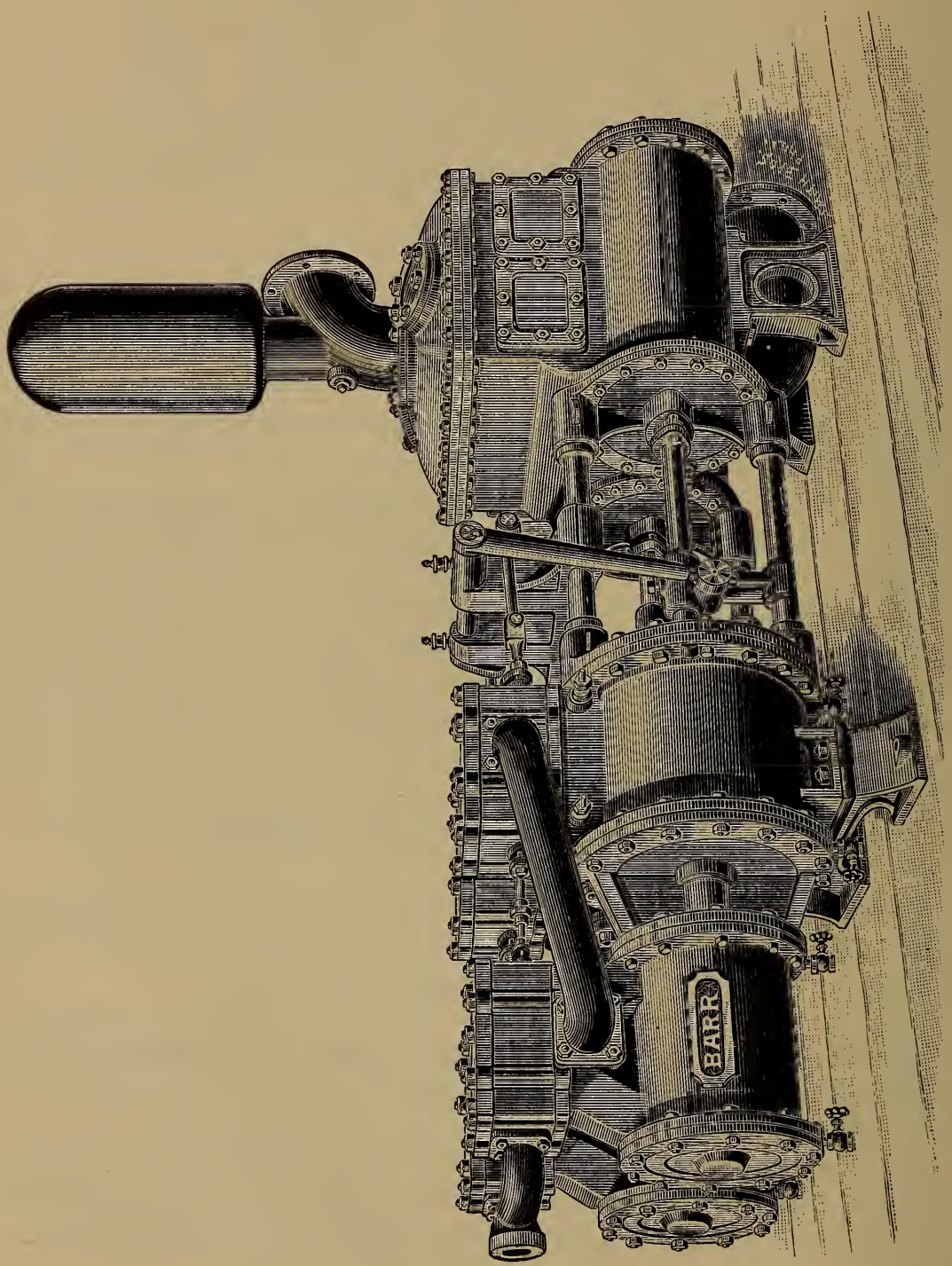
Any of our compound or other steam-ends can be fitted with reeded black walnut lagging, ornamented with brass bands. Planished iron, similarly ornamented, can also be furnished.

Whichever style of lagging may be selected will have underneath it a properly prepared non-conducting clothing, hair felt being usually employed with the black walnut lagging, and wood staves with the planished iron.

It is customary to give the pump an extra finish when the steam-cylinders are lagged. This extra finish is confined to such parts of the valve-gear and steam-end as are usually painted, unless an extra finish is desired.

The lagging and extra finish add very much to the appearance of the pump, and at a very moderate cost.

COMPOUND DUPLEX PUMP.



Size, 12 and 18 x 10 x 12.

COMPOUND DUPLEX STEAM-PUMPS.

The ratio of the high- and low-pressure cylinders to each other will depend upon the steam pressure, and whether or not a condensing apparatus is to be employed. For ordinary low pressures, say from sixty to seventy-five pounds, a ratio of 2½ to 3 areas is employed for non-condensing compound steam-ends; but for steam pressures above ninety pounds, and in connection with a condensing apparatus, a ratio of 4 to 1 is recommended. Dimensions and prices for sizes not given in this table will be furnished on application.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
6 and 10	6	12	1.47	75 to 125	220 to 367	294	17,640	433,360	1½	2½	5	4	
7 and 12	6	12	1.47	75 to 125	220 to 367	294	17,640	433,360	1½	3	5	4	
8 and 12	6	12	1.47	75 to 125	220 to 367	294	17,640	433,360	1½	3	5	4	
6 and 10	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	1½	2½	6	5	
7 and 12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	1½	3	6	5	
8 and 12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	1½	3	6	5	
9 and 14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	4	6	5	
10 and 16	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	4	6	5	
8 and 12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	1½	3	6	5	
9 and 14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	4	6	5	
10 and 16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	4	6	5	
12 and 18	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	5	6	5	
14 and 20	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	5	6	5	
8 and 12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	1½	3	8	7	
9 and 14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2	4	8	7	
10 and 16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2	4	8	7	
12 and 18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	5	8	7	
14 and 20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	5	8	7	
8 and 12	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	1½	3	10	8	
9 and 14	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	2	4	10	8	
10 and 16	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	2	4	10	8	
12 and 18	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	2½	5	10	8	
14 and 20	12	12	5.87	75 to 125	880 to 1467	1174	70,440	1,690,560	3	5	10	8	
10 and 16	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	2	4	12	10	
12 and 18	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	2½	5	12	10	
14 and 20	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	3	5	12	10	
16 and 24	14	12	8.00	75 to 125	1200 to 2000	1600	96,000	2,304,000	3	6	12	10	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

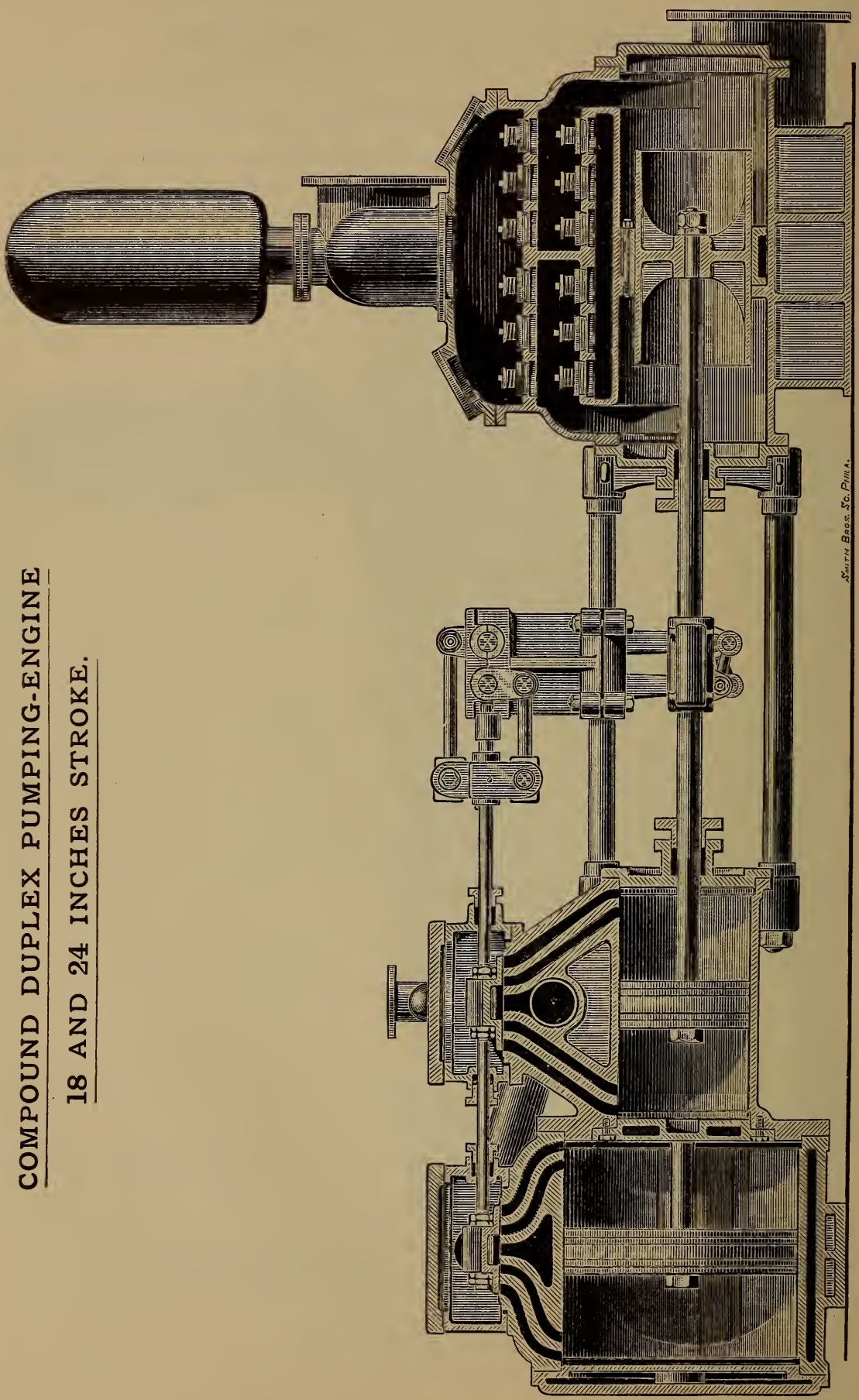
An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 6 and 10 x 6 x 12 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.

COMPOUND DUPLEX PUMPING-ENGINE

18 AND 24 INCHES STROKE.



COMPOUND DUPLEX PUMPS 18 AND 24 INCHES STROKE.

The selection given below will meet the average requirements for water-works pumping-engines ranging from one and a half to five millions daily capacity. Our condensing apparatus is recommended in connection with these pumps, thereby increasing the power and lessening the fuel consumption. Other proportions and sizes will be quoted upon if the conditions of service are made known to us.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.			Diameter of Pipes in Inches. (Subject to Change.)				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
10 and 16	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	2	4	12	10	
12 and 18	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	2½	5	12	10	
14 and 20	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3	5	12	10	
16 and 26	12	18	8.80	53 to 80	933 to 1408	1170	70,200	1,684,800	3	6	12	10	
12 and 18	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	2½	5	12	10	
14 and 20	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3	5	12	10	
16 and 26	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3	6	12	10	
18 and 30	14	18	12.00	53 to 80	1272 to 1920	1596	95,760	2,298,240	3½	7	12	10	
14 and 20	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3	5	14	12	
16 and 26	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3	6	14	12	
18 and 30	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3½	7	14	12	
20 and 32	16	18	15.67	53 to 80	1660 to 2506	2084	125,040	3,000,960	3½	7	14	12	
16 and 26	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	3	6	14	12	
18 and 30	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	3½	7	14	12	
20 and 32	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	3½	7	14	12	
22 and 36	16	24	20.88	40 to 60	1670 to 2506	2088	125,280	3,006,720	4	8	14	12	
18 and 30	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	3½	7	16	14	
20 and 32	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	3½	7	16	14	
22 and 36	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	4	8	16	14	
24 and 40	18	24	26.44	40 to 60	2115 to 3173	2644	158,640	3,807,360	4	8	16	14	
18 and 30	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	3½	7	18	16	
20 and 32	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	3½	7	18	16	
22 and 36	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	4	8	18	16	
24 and 40	20	24	32.64	40 to 60	2611 to 3917	3264	195,840	4,700,160	4	8	18	16	
22 and 36	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	4	8	20	18	
24 and 40	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	4	8	20	18	
26 and 44	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	4	8	20	18	
28 and 48	22	24	39.48	40 to 60	3158 to 4737	3948	236,880	5,685,120	5	10	20	18	
30 and 50	22	24	39.48	40 to 60	3158 to 4737	3984	236,880	5,685,120	5	10	20	18	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke: thus, 10 and 16 x 12 x 18 for the first pump in the table, and similarly for any other size.

WATER-WORKS PUMPS.

Referring to the several designs illustrated in the preceding pages, together with the tables relating to sizes and capacities, it is thought that a selection can easily be made for pumping machinery suited to the requirements of small and medium-sized water-works. We are prepared to furnish these pumps either as ordinary duplex or with compound steam-ends; both kinds can be fitted with our independent condensing apparatus. A list of duplex plunger-pumps, of 12 inches stroke, up to 1,500,000 gallons daily capacity is given on page 13,—the interior arrangement of the pump being shown on page 12. This design is the ordinary plunger and ring, having no adjustment, and is the best kind of pump for clear water. Another design, adapted for muddy and gritty water, is shown on page 18; it is in no respect different from the above-mentioned pump except that the plunger-ring contains a stuffing-box, fitted with a gland, and adapted for the use of Tuck's packing; in other words, an inside-packed plunger-pump. An outside-packed plunger-pump is shown on page 20, and a table of sizes, etc., on page 21.

For duplex piston-pumps, of 12 inches stroke, the reader is referred to page 14 for a sectional elevation, and page 15 for a table of sizes and capacities up to 2,000,000 gallons daily capacity.

Duplex pumps, of 18 and 24 inches stroke, ranging from 1,500,000 to 5,000,000 gallons daily capacity is given on page 27. These pumps will be made in any of the styles previously described, or specially designed to order when the conditions of service are made known to us.

A list of compound duplex pumps, of 12 inches stroke, is given on page 55. The general elevation given on page 54 shows the design usually adopted for small compound steam-ends. On page 56 is a sectional elevation giving the general arrangement of the larger sizes.

A table of sizes and capacities for compound duplex pumps, of 18 and 24 inches stroke, from 1,500,000 to 5,000,000 gallons daily capacity, is given on page 57. The dimensions given in the table are those which have found favor with water-works managers for sizes up to 5,000,000 gallons daily capacity, but in addition to the sizes given we are prepared to make pumps on this same general design having a greatly increased pumping capacity.

We are prepared to undertake the erection of pumping-stations, furnishing pump, boilers, and everything complete inside of the engine-room, and shall be in readiness at all times to send drawings and specifications of pumping machinery if the conditions of service are made known to us.

INDEPENDENT CONDENSING APPARATUS.

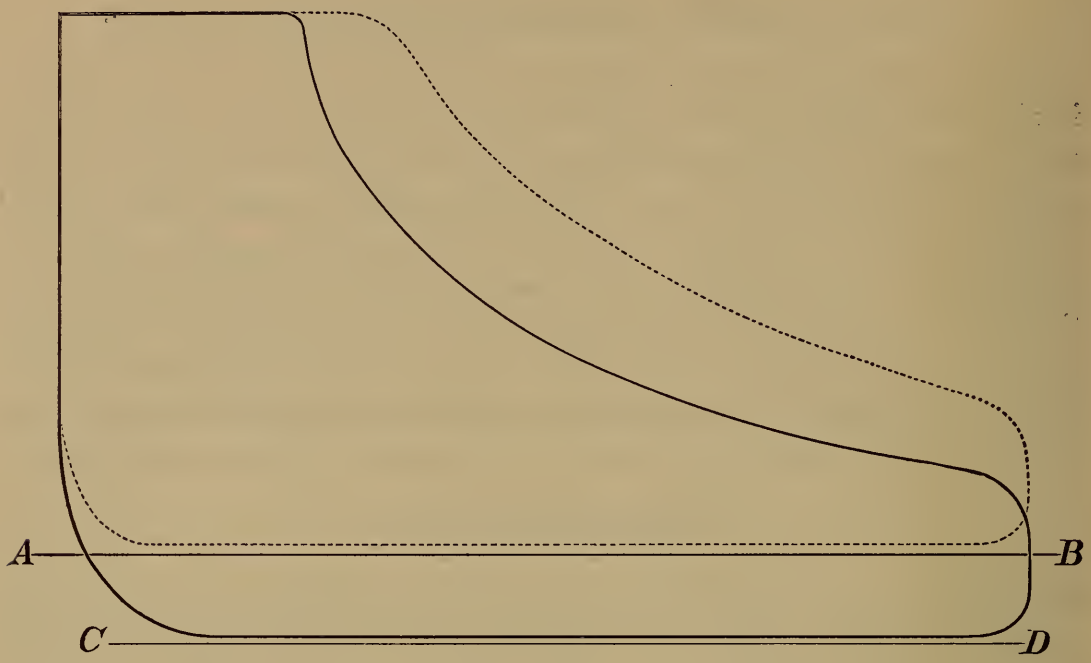
It is a well-known fact that the atmosphere exerts a back pressure in all steam-engines equal to 14.7 pounds per square inch of piston area; also, that water converted into steam may be reconverted into its original state by condensation. Now, if this condensation be effected in a closed vessel, a vacuum is formed, and if such a vessel is properly made and attached to the exhaust-pipe of a steam-engine, by far the greater portion of the pressure of the atmosphere can not only be removed as back pressure, but be made to do useful work on the opposite side of the piston to which the vacuum occurs. It is such an apparatus that we wish to bring to the attention of owners and managers of steam machinery.

CONDENSATION,

As applied to the steam-engine, means taking the exhaust steam which would otherwise be allowed to escape into the open air, and conveying it into a closed vessel, where it is met by a spray of cold water, which so rapidly absorbs the heat contained in the steam that it ceases to retain its gaseous form, and is again reduced to its original bulk as water, occupying about $\frac{1}{1300}$ less space as water than it occupied as steam. This difference in volume accounts for the atmospheric pressure on the outside of the chamber or pipe, and as the vacuum extends throughout the whole distance which the exhaust steam originally occupied, it, of course, is made available in the cylinder of an engine in the shape of decreased pressure on the exhaust side of the piston; the atmospheric pressure remains constant, therefore we have the atmospheric pressure acting on one side of the piston and absent on the other, the gain being 14.7 pounds per square inch if a perfect vacuum is had. It amounts in average engineering practice to from 12 to 13 pounds, or 24 to 26 inches of mercury, as the graduations of vacuum-gauges usually read.

GAIN BY THE USE OF A CONDENSER.

The gain to be secured by the employment of a condensing apparatus may be measured in two ways: First, by the decrease in fuel consumption over that necessary when running non-condensing—this will represent a constant decrease in running expenses; or, second, by increasing the power so that, for a given engine working nearly or quite up to its economical limit non-condensing, a still further addition to the power is had by increasing the mean effective pressure of steam in the engine-cylinder without the use of additional steam from the boiler.



By way of illustration we insert a diagram of an 18 x 36 inch automatic cut-off engine, in which two diagrams are laid down upon the same atmospheric line. The dotted diagram represents the engine running non-condensing, the pressure of steam being 90 pounds per gauge or 105 pounds absolute; the point of cut-off is nearly, but not quite, three-eighths of the stroke; the back pressure is 16 pounds absolute, or one pound above the atmosphere, the engine running at 100 revolutions per minute, the mean effective pressure being about 58½ pounds, thus developing 270 horse-power. By the use of a condensing apparatus the engine did the same work following one-quarter stroke instead of three-eighths as formerly, the indicated horse-power being exactly the same; this represents a saving in steam of 27.5 per cent. Let us suppose that an increase of power was desired without putting in a new engine, and that instead of cutting off shorter, the point of cut-off remained the same; then we would have, by reason of the vacuum, an increase in mean effective pressure from 58.5 pounds to 73 pounds; this would increase the power of the engine from 270 horse-power to 337 horse-power, a gain of 25 per cent. over the non-condensing engine without increasing the boiler capacity.

These two examples will suffice to show that a very slight additional outlay to the original cost of the engine and boiler will yield a good return on the investment, and we urge its adoption in all cases where a good supply of injection water can be had.

INJECTION WATER.

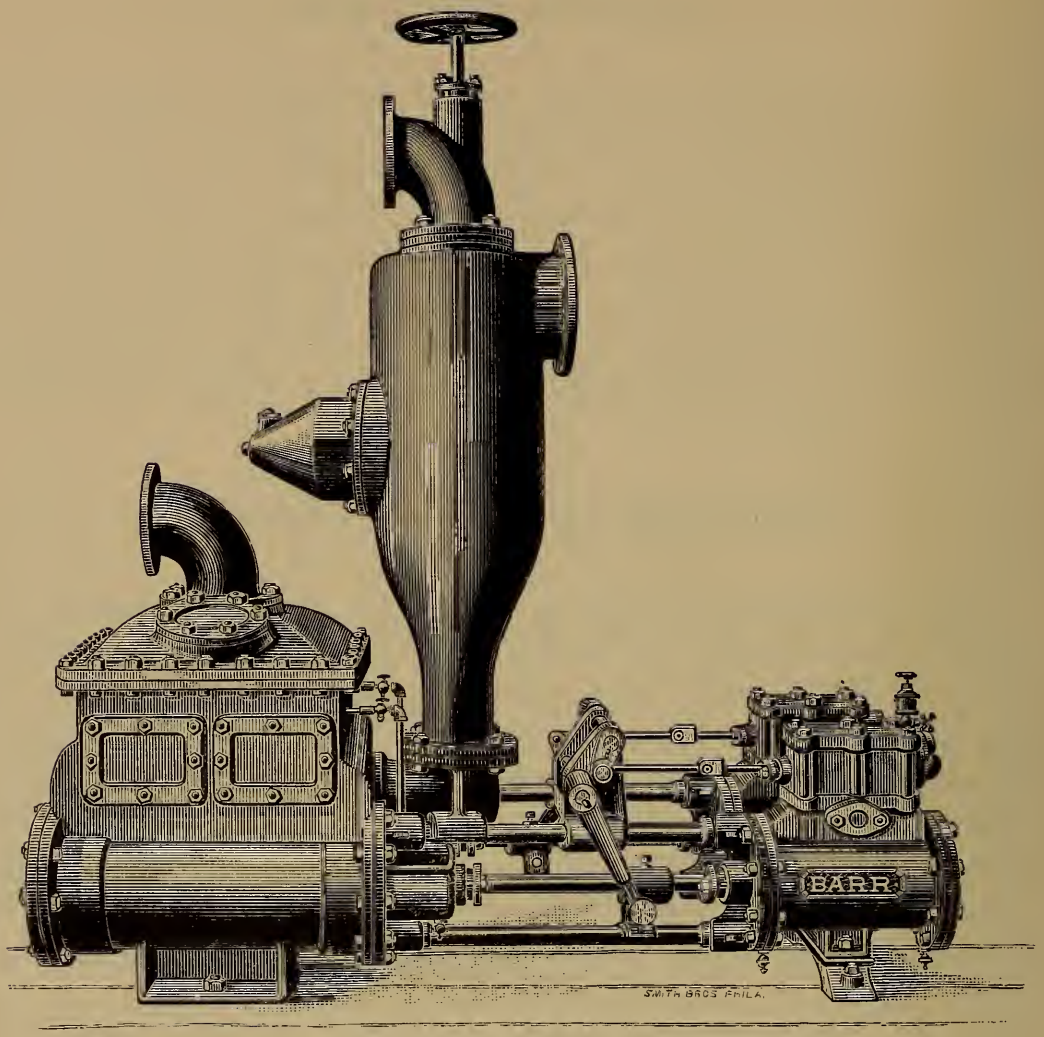
In round numbers, twenty-five times as much water is required to condense the exhaust steam from an engine as was evaporated in the boilers to form it. The actual quantity will vary, being lowest in the winter months and highest in the summer months, if obtained from a running stream; if the supply is had from a well, the quantity will remain more nearly constant. A very convenient factor is to allow 1½ gallons per horse-power per minute for high-grade automatic-engines, and from 2 to 2½ gallons per horse-power per minute for ordinary slide-valve or single-valve engines.

TEMPERATURE OF DISCHARGE.

The temperature of the water discharged from the condenser will probably range between 100° and 120°. The lower the temperature of the discharge the greater must be the quantity of the injection water admitted, and this quantity may, under some conditions, be in excess of the highest economy; so that, under average conditions, we do not think anything is gained in the attempt to carry the vacuum beyond 26 or 27 inches. The former figure may be considered a good vacuum, and is easily had and maintained. There are conditions in which 28 to 29 inches are had, but they do not apply to every-day practice.

UTILIZING DISCHARGE WATER.

In manufacturing establishments where large quantities of water are required, advantage can be taken of the fact that in condensing apparatus of our make, the water, after performing useful work in the condensing-chamber, can be elevated to a tank in any portion of the building and used over again for another purpose, such as washing, cooling metal plates, rolling mill-rolls, etc. The fact that the temperature of this discharge water will range from 100° to 120° will in many cases be advantageous and effect a saving in the cost of heating other water for purposes in which this discharge water will answer equally well. In the sketch on page 64 we show a method of piping which will be found to answer the purpose very well. When the water is not required in the tank, the stop-valve may be opened and the water allowed to escape into a drain or any other convenient place.



AIR-PUMP.

After the steam has been condensed, some provision must be made for the disposal of the water which would otherwise accumulate in the bottom of the condensing-chamber and render it inoperative. This is usually a reciprocating-pump, although other methods have been employed, but not with the same satisfactory results. The function of the air-pump is solely to get rid of the water in the condenser; it adds nothing to the efficiency of the condensing apparatus except to render its operation continuous.

If, for any reason, the air-pump should become inoperative, and an accumulation of water occur in the condensing-chamber, a float is provided, as shown, which will open an air-valve and break the vacuum, thus preventing an overflow into the engine.

INDEPENDENT CONDENSING APPARATUS.

The proportions of steam- to water-cylinders in the table given below are those for ordinary service only. If the water is to be elevated into a tank, or any other service required of it in which an additional load is brought upon the steam-cylinders, they should be increased in diameter.

All air-pump pistons are fitted for the use of Tuck's or similar fibrous packing; the water-cylinders are lined with brass; the valves are selected with special reference to the service required of them; the piston-rods are made of brass, and are water-sealed at the pump-end.

No. of Condenser.	Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	PRICE.	DIMENSIONS OF				
					Steam Pipe.	Exhaust Pipe of Pump.	Engine Exhaust Pipe.*	Injection Pipe.	Delivery Pipe.
1	5	4	8		1	1¼	4	2½	2½
2	5	5	8		1	1¼	5	3	3
3	5	6	8		1	1¼	6	3½	3½
4	6	7	10		1	1½	6	4	4
5	6	7	12		1½	2	7	4	4
6	6	8	12		1½	2	8	5	5
7	8	10	12		1½	2	9	6	6
8	9	12	12		2	2½	10	7	7
9	10	12	12		2	2½	10	7	7
10	10	12	18		2	2½	10	7	7
11	10	14	18		2	2½	12	8	8
12	12	16	18		2½	3	14	10	10

*The size of opening for engine exhaust may be varied to suit special requirements. Unless otherwise ordered the standard size will be furnished.

The Independent arrangement permits the apparatus to be started in advance of the engine, thus increasing the power at a time when most needed, and allows the speed to be varied to conform to changing conditions of injection and load.

The Duplex style gives a uniform motion, insuring durability of all working-parts and an extremely steady vacuum.

The Injection supply to the Condenser is controlled by a valve and spray-pipe of special design, which secures accurate adjustment and prevents clogging.

A Safety-attachment is provided which under all circumstances prevents the flooding of the engine.

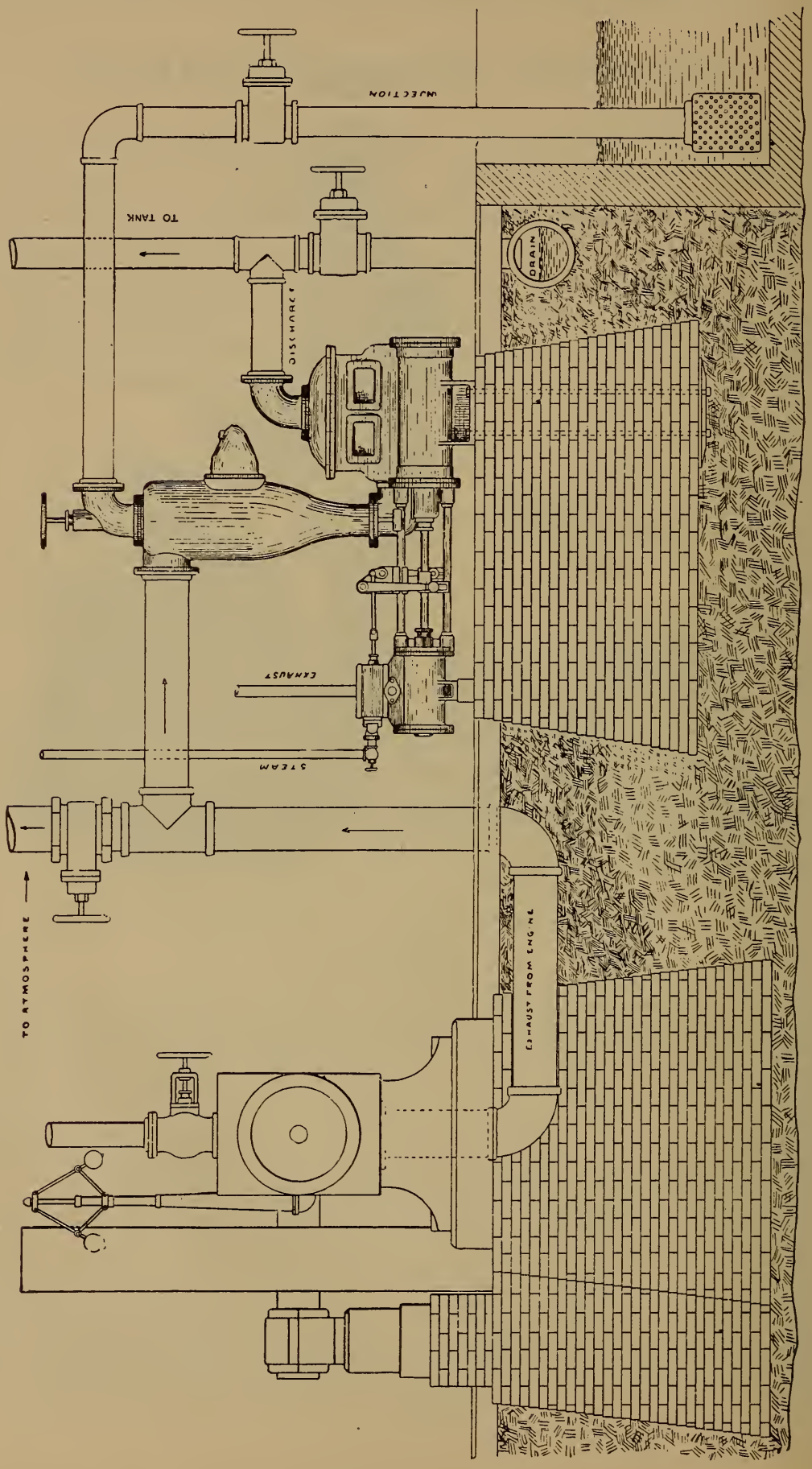
A water-seal for the suction-valves, as well as for the pistons and rods, is provided.

Every detail is designed with reference to convenience of management, durability, and highest efficiency.

To superiority of design is added the best possible material and workmanship.

The Injection supply, within the limits of suction-lift, is raised by the apparatus itself, and the discharge can be delivered to an elevation if desired.

Inquiries should be accompanied by as full particulars as possible of the conditions, such as:—1. Diameter of engine-cylinder and length of stroke. 2. Revolutions per minute. 3. Steam-pressure. 4. Point of stroke at which steam is cut off. 5. Style or make of engine and the horse-power. 6. Indicator diagram if convenient. 7. Water supply for injection, whether salt or fresh; distance from engine, and approximate height from surface to engine-room floor.


SUCTION
TO TANK
DISCHARGE
DRAIN
EXHAUST
STEAM
TO ATMOSPHERE
EXHAUST FROM ENGINE

PIPING A CONDENSER.

On the opposite page is a sketch showing the essential details in piping a condenser, subject, of course, to such changes in direction and location of pipes as may be required to suit any particular engine.

In leading the exhaust from the engine, provision should be made for escape into the atmosphere when, for any reason, it is desirable or necessary to run the engine non-condensing. We have shown a straight-way valve above the tee, connecting with the condensing-chamber; instead of this valve, we can furnish a check-valve which will open automatically if for any cause the condenser ceases to operate.

The injection water may be taken from any convenient source of supply; the lower end of the pipe should be provided with a strainer to keep out floating leaves, twigs, fish, etc. A straight-way valve should be located at some convenient position near the condenser. The hand-wheel on top of the condenser operates an adjustable valve in the spray-pipe; its function is simply to regulate the quantity of water passing through the perforated spray-pipe, and is not intended, nor can it be used, as a stop-valve; therefore, the straight-way valve shown in the injection-pipe should not be omitted.

The discharge-pipe may lead in any convenient direction. The water can be elevated by the condensing apparatus to any height desired. The sketch shows a straight-way valve by which the water discharged from the condenser may be elevated into a tank overhead by simply closing the valve; should no further supply be required in the tank, the valve may then be opened, and the water allowed to escape in the drain.

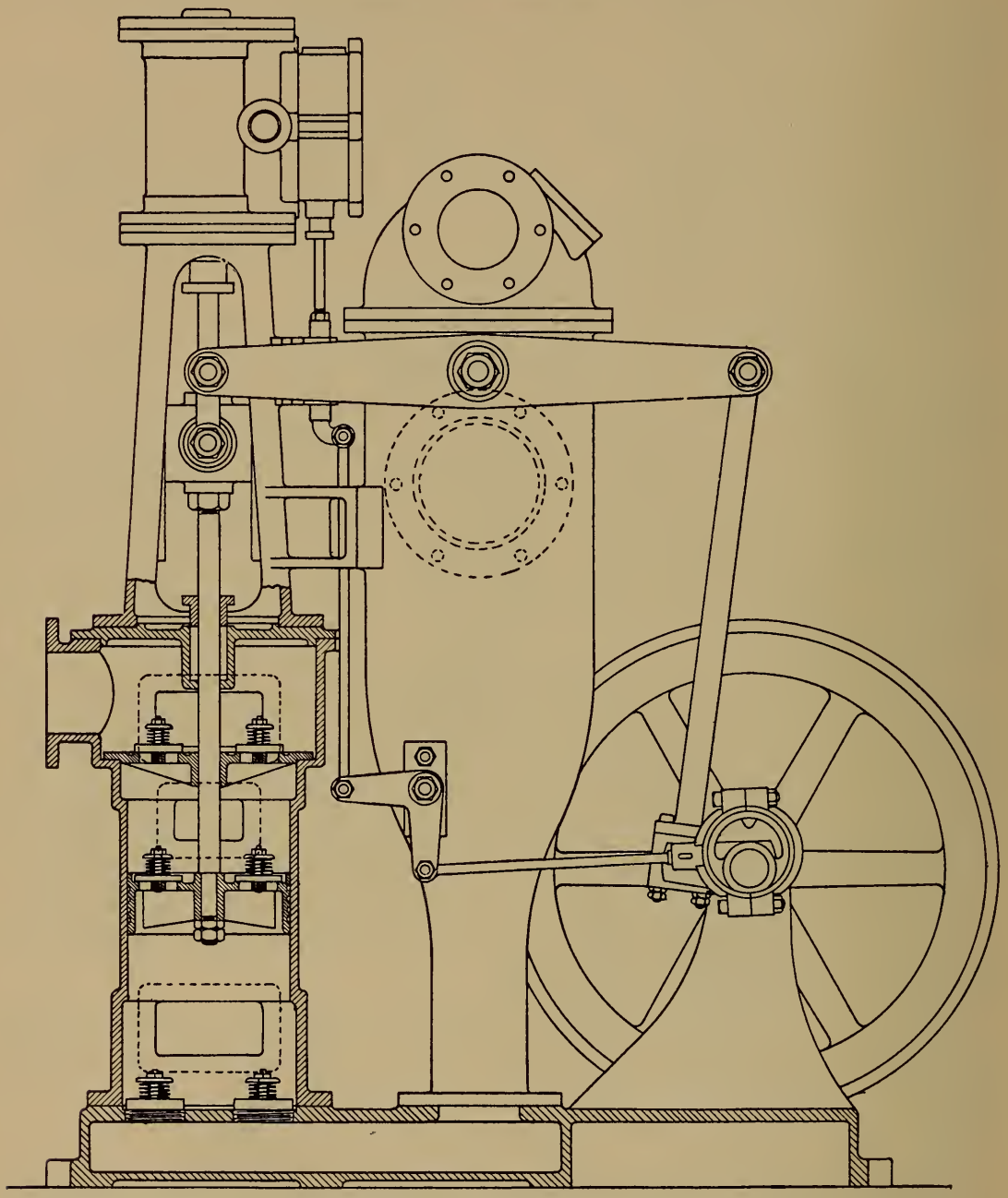
These suggestions in regard to piping do not refer to any steam-plant in particular, but merely show one method of piping which has been very satisfactory in its operation.

We shall be glad to design a system of piping in connection with our condensing apparatus if customers will acquaint us with the facts in the case.

The height of a Condenser above the source of injection-water supply should be as little as possible; a distance of eighteen to twenty feet ought not to be exceeded, and may be as much less as circumstances will permit. For high lifts of injection-water a charging-valve and overhead supply will be found very advantageous in starting the condenser; this supply should be shut off as soon as a vacuum is had.

Start the condensing apparatus in advance of the engine, and shut down the engine before stopping the condenser.

INDEPENDENT CONDENSING APPARATUS, WITH VERTICAL AIR-PUMP.



Crank and Fly-Wheel Pattern. Mounted on Bed-Plate.

These pumps can be made to operate with a belt instead of an engine. Sizes and prices on application.

Inquiries should be accompanied by as full particulars as possible of the conditions, such as:—1. Diameter of engine-cylinder and length of stroke. 2. Revolutions per minute. 3. Steam pressure. 4. Point of stroke at which steam is cut off. 5. Style or make of engine and the horse-power. 6. Indicator diagram, if convenient. 7. Water-supply for injection, whether salt or fresh; distance from engine, and approximate height from surface to engine-room floor.

INDEPENDENT CONDENSING APPARATUS, WITH VERTICAL AIR-PUMP.

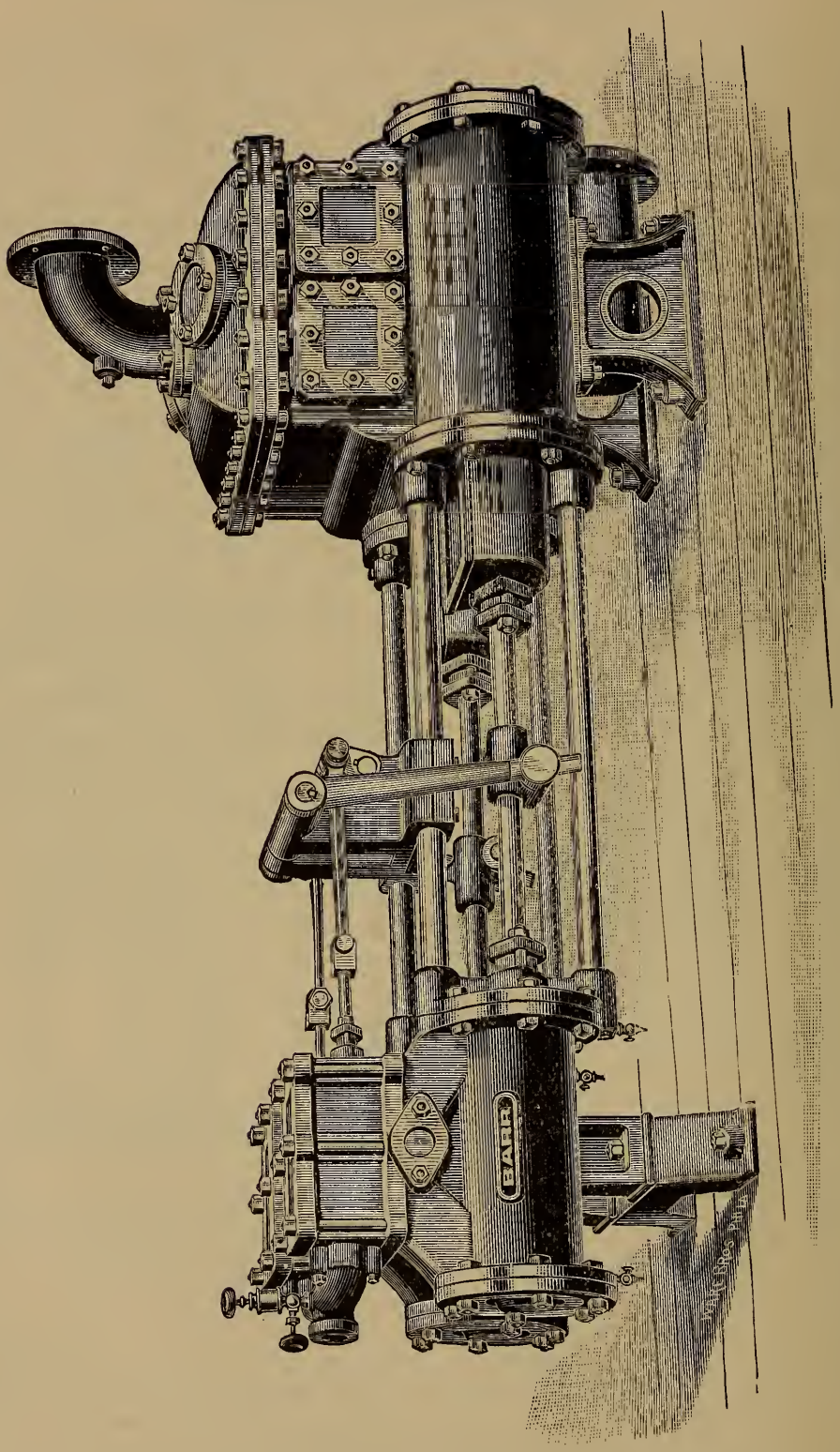
In addition to the condensing apparatus previously described, we are now prepared to furnish an apparatus of the design illustrated on the opposite page. The details of the condenser have already been described. The air-pump in this design is of the single-acting type so long and satisfactorily employed in marine practice. The water of condensation, together with the injection-water, passes from the jet-condenser into a receiving-chamber included in the bed-plate of the apparatus. The piston of the air-pump being vertical is always submerged on the lower half of the stroke; it is fitted with valves as shown, and another set of valves at the top of the working-barrel. It will be seen that the three sets of valves are wholly submerged, so that there is no chance whatever for air leakage. Each set of valves is provided with openings and hand-hole plates so that they may be examined or repaired without disturbing the main framing of the pump. The crank and fly-wheel measures the length of stroke, so that a fixed displacement is had at each revolution.

The following list of sizes will meet the ordinary requirements of the trade, but we are prepared to make independent condensing apparatus of this type in any size.

Diameter of Steam-Cylinder.	Diameter of Water-Cylinder.	Length of Stroke.	Displacement in Gallons for One Revolution.	DIMENSIONS OF					PRICE.
				Steam-Pipe.	Exhaust-Pipe of Pump.	Engine Exhaust-Pipe.*	Injection-Pipe.	Delivery-Pipe.	
6	7	10	1.66	1	1¼	5	3½	3½	
6	8	10	2.16	1	1¼	6	4	4	
6	9	10	2.71	1	1¼	6	4	4	
7	10	12	4 08	1	1¼	7	5	5	
8	12	12	5.88	1¼	2	8	5	5	
10	14	12	8.00	1¼	2	9	6	6	
10	16	12	10.44	1¼	2	10	6	6	
12	18	12	13 22	1½	2½	10	7	7	
12	20	18	24.48	1½	2½	12	8	8	
14	24	18	35.28	2	3	14	10	10	
16	28	18	48.00	2	3	16	12	12	

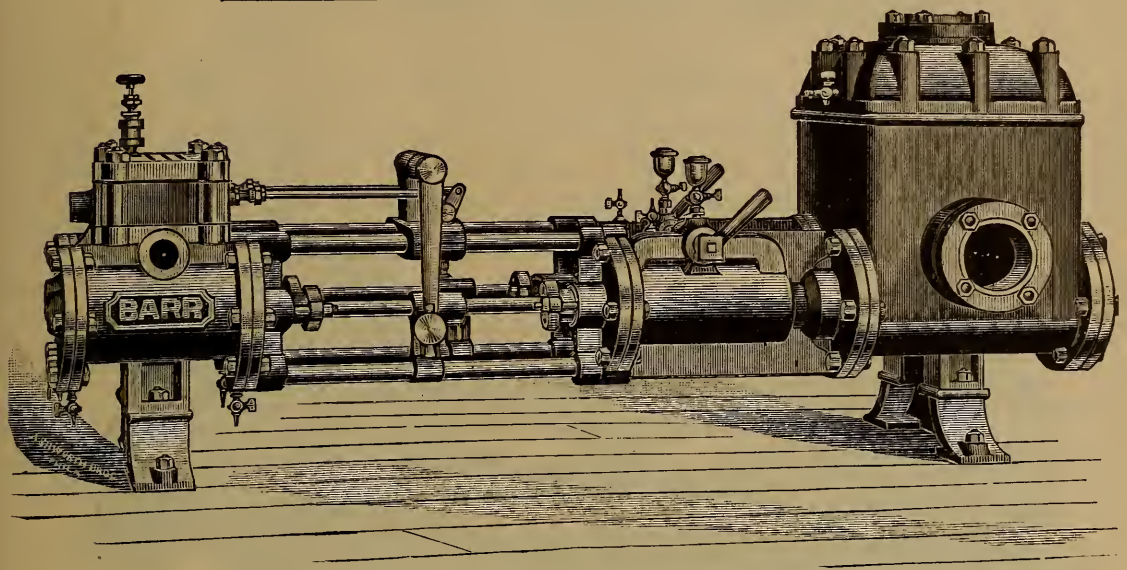
*The size of opening for engine exhaust may be varied to suit special requirements. Unless otherwise ordered, the above size will be furnished.

DUPLEX AIR- OR VACUUM-PUMP.



Size, 6 x 8 x 12.

DUPLEX AIR- OR VACUUM-PUMP.



5 x 6 x 8 Air- or Vacuum-Pump, with Cataract.

These pumps are adapted for service on shipboard, and are designed for use with surface condensers. Pumps will be fitted either with or without cataract, to meet the requirements of any special service.

Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at a Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches. (Subject to Change.)				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
5	4	8	.43	75 to 125	64 to 107	85	5,100	1	1¼	3	2	
5	5	8	.68	75 to 125	102 to 170	136	8,160	1	1¼	4	2½	
5	6	8	.98	75 to 125	147 to 245	196	11,760	1	1¼	4	3	
6	7	10	1.66	75 to 125	249 to 415	332	19,920	1	1½	5	4	
6	7	12	2.00	75 to 125	300 to 500	400	24,000	1½	2	5	4	
6	8	12	2.61	75 to 125	391 to 652	522	31,320	1½	2	6	5	
8	10	12	4.08	75 to 125	612 to 1020	816	48,960	1½	2	7	6	
9	12	12	5.87	75 to 125	880 to 1467	1174	70,440	2	2½	8	7	
10	12	12	5.87	75 to 125	880 to 1467	1174	70,440	2	2½	8	7	
10	12	18	8.80	50 to 90	880 to 1584	1232	73,920	2	2½	8	7	
10	14	18	12.00	50 to 90	1200 to 2160	1680	100,800	2	2½	10	8	
12	16	18	15.66	50 to 90	1566 to 2818	2192	131,544	2½	3	12	10	

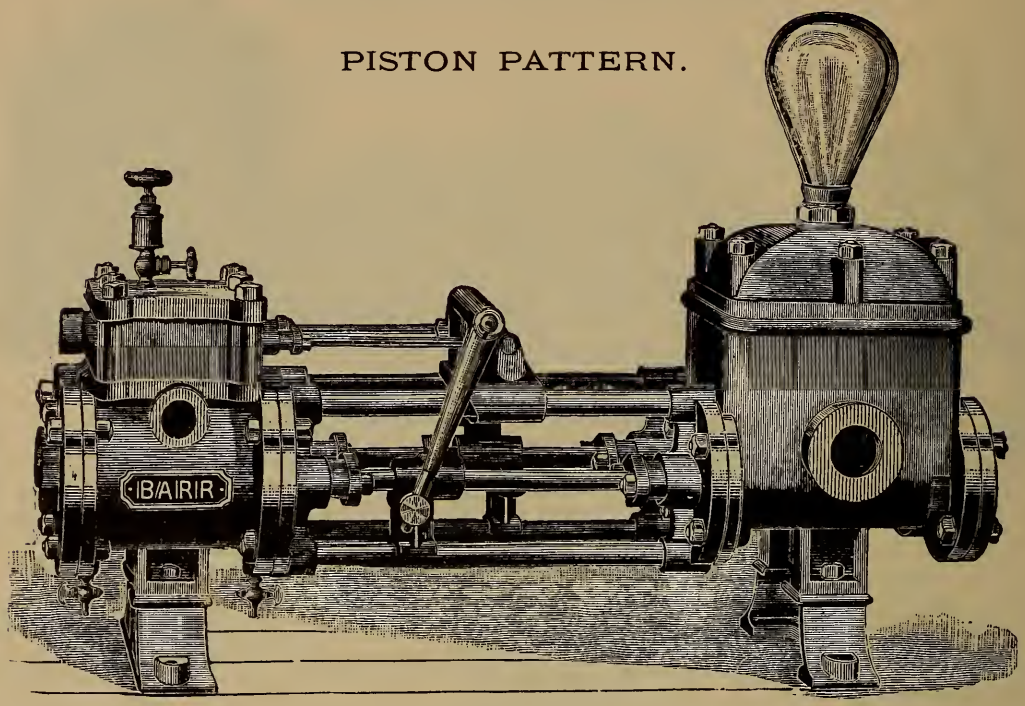
Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke: thus, 5 x 4 x 8 for the first pump in the table, and similarly for any other size.

DUPLEX CIRCULATING-PUMPS.

PISTON PATTERN.



These pumps are fitted with brass linings, packed pistons, and brass rods for salt water. They are double acting, the valve-gear is all in plain sight, no concealed parts, no dead centre; the delivery of water is at all times constant and uniform.

Diameter of Steam-Cylinders.	Diameter of Water-Cylinders.	Length of Stroke.	Gallons per Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE. Brass-Fitted.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	3	5	.15	100 to 200	30 to 60	45	2,700	¾	1	2	1½	
4	4	5	.27	100 to 200	54 to 108	81	4,860	¾	1	2	1½	
5	4	6	.33	100 to 175	66 to 115	91	5,460	1	1¼	3	2	
5	5	6	.51	100 to 175	102 to 178	140	8,400	1	1¼	3	2	
6	5	8	.68	100 to 150	136 to 204	170	10,200	1	1½	4	2½	
6	6	8	.98	100 to 150	196 to 294	245	14,700	1	1½	4	2½	
8	6	10	1.22	75 to 125	183 to 305	244	14,640	1½	2	4	3	
8	7	10	1.66	75 to 125	249 to 415	332	19,920	1½	2	5	4	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

For larger sizes, see page 16.

BILGE-PUMPS AND BALLAST-PUMPS.

The pumps tabulated on pages 9 and 16 will meet the ordinary requirements of either service, and can be furnished in either the plunger or piston pattern; the latter, with packed pistons, are usually employed. These pumps are brass-fitted throughout for salt water.

Pumps less than 12 inches stroke have the water-cylinders lined with brass seamless-drawn tubing. Water-ends of 12 inches stroke have removable cast-brass linings, as illustrated on page 14.

WRECKING-PUMPS.

Vertical single-acting wrecking-pumps are extensively used wherever a large volume of water has to be lifted and delivered within ordinary suction limits. The pump cannot deliver water above the curb which surrounds the top of the water-cylinder.

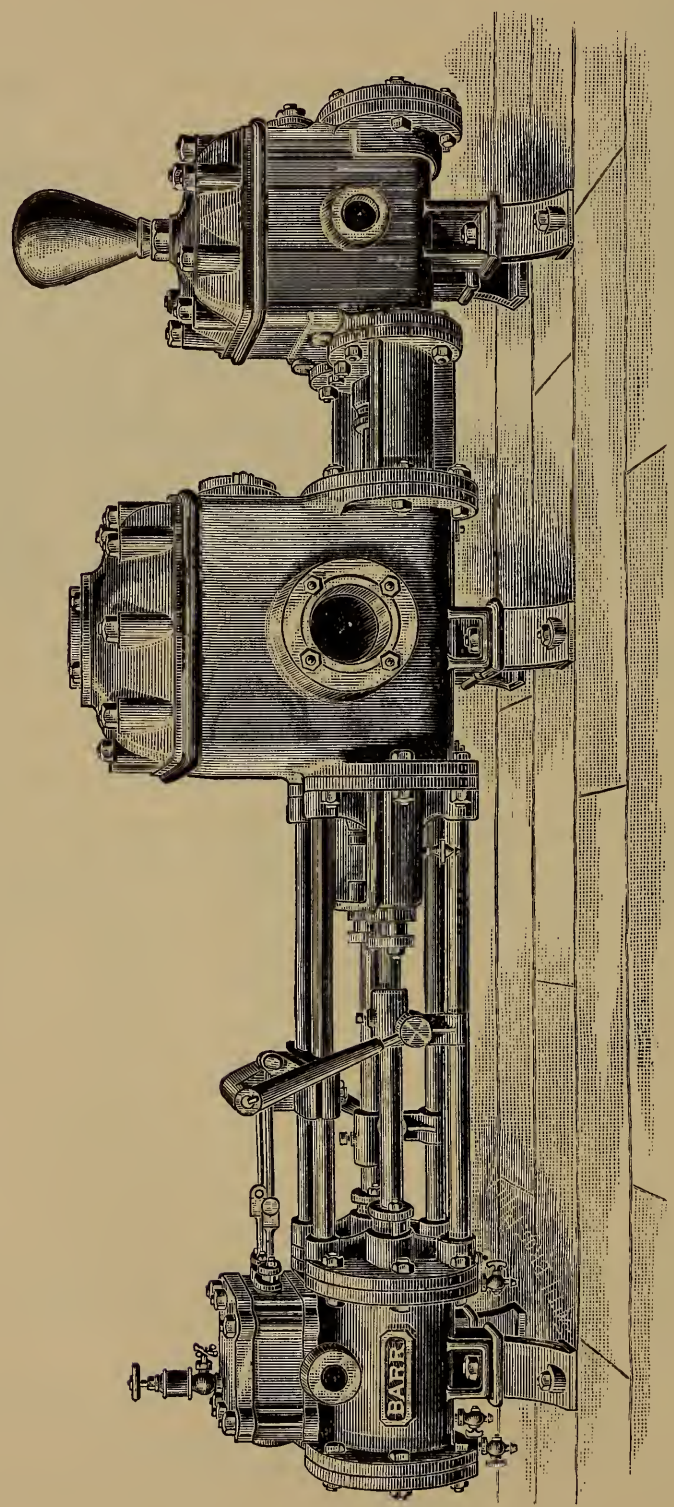
Steam-Cylinder. Inches.	Water-Cylinder. Inches.	Stroke. Inches.	Capacity at 150 Feet Piston Speed. Gallons.	Steam-Pipe. Inches	Exhaust-Pipe. Inches.	Suction-Pipe. Inches.	PRICE.	
							Fitted for Fresh Water.	Brass-Fitted for Salt Water.
6	12	12	435	1¼	1½	6		
8	16	12	783	1½	2	8		
10	20	12	1224	1½	2	10		
12	24	12	1762	2	2½	12		
14	30	18	2754	2½	3	14		
16	36	18	3966	2½	3	18		

For irrigating purposes these pumps present special advantages, being light, easily handled, simple in construction, durable in use, and of large capacity.

The valves are of vulcanized rubber, the valve-seats of gun-metal composition, and of the design illustrated on page 17.

When ordering, please state whether the pump is to be used for fresh or for salt water.

COMBINED DUPLEX AIR-PUMP AND BOILER FEED-PUMP.



Size, 6 x 6 x 3 x 8.

COMBINED DUPLEX AIR AND BOILER FEED-PUMPS,

FOR STEAM-TUGS, YACHTS, ETC.

This style of pump does not differ materially from those tabulated on page 68, except in the addition of the boiler feed-pump. Both water-ends are brass lined, and fitted with brass pistons adapted for the use of Tuck's or other fibrous packing. The piston-rods are of brass, and provided with water-sealed stuffing-boxes. Valves will be furnished of metal or rubber adapted to the service required. In making comparisons it should be borne in mind that our duplex pumps have two steam-cylinders and two double-acting pistons, therefore double the capacity of a single pump of the same dimensions.

Diameter of Steam-Cylinders.	Diameter of Air-Pump.	Diameter of Feed-Pump.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.		Ordinary Strokes per Minute of One Piston.	Displacement in Gallons by Both Pistons at 100 Strokes per Minute.		SIZE OF PIPES. (Subject to Change according to Service.)						PRICE.
									Air-Pump.		Feed-Pump.		Steam-End.		
				Air-Pump.	Feed-Pump.		Air-Pump.	Feed-Pump.	Suction.	Delivery.	Suction.	Delivery.	Steam.	Exhaust.	
6	4	2	8	.43	.11	75 to 125	86	22	3	2	1½	1	1	1½	
6	5	3	8	.68	.24	75 to 125	136	48	4	2½	2	1½	1	1½	
6	6	3	8	.98	.24	75 to 125	196	48	4	2½	2	1½	1	1½	
8	7	3	10	1.66	.30	75 to 125	332	60	5	4	2	1½	1½	2	
8	7	3	12	2.00	.37	75 to 125	400	73	5	4	2	1½	1½	2	
8	8	3	12	2.61	.37	75 to 125	522	73	6	5	2	1½	1½	2	
9	10	4	12	4.08	.65	75 to 125	816	130	7	6	3	2	2	2½	
10	12	4	12	5.87	.65	75 to 125	1174	130	8	7	3	2	2	2½	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates.

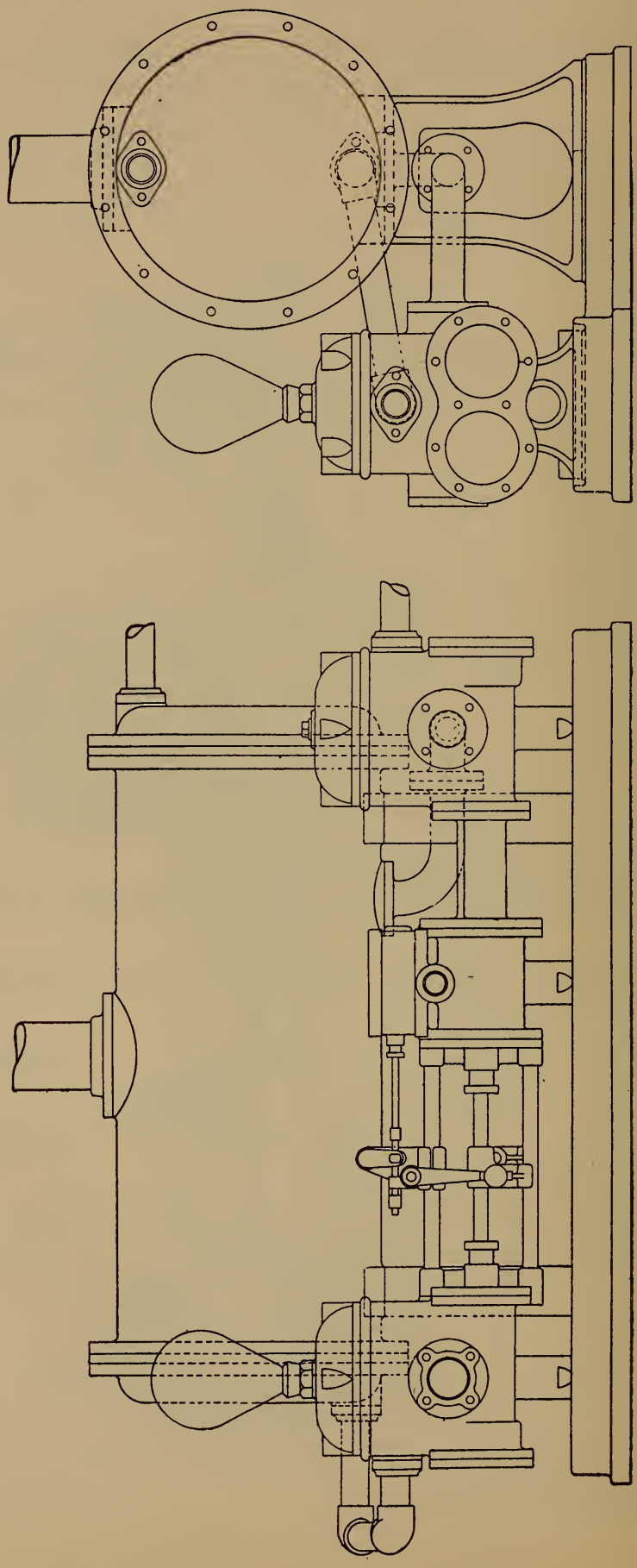
Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 6 x 4 x 2 x 8 for the first pump in the table, and similarly for any other size.

COMBINED DUPLEX AIR AND CIRCULATING PUMPS.

Diameter of Steam-Cylinders.	Diameter of Air-Pump.	Diameter of Circulating-Pump.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.		Ordinary Strokes per Minute of One Piston.	Displacement in Gallons by Both Pistons at 100 Strokes per Minute.		SIZE OF PIPES. (Subject to Change according to Service.)						PRICE.
									Air-Pump.		Circulating-Pump.		Steam-End.		
				Air-Pump.	Circulating-Pump.		Air-Pump.	Circulating-Pump.	Suction.	Delivery.	Suction.	Delivery.	Steam.	Exhaust.	
6	5	5	8	.68	.68	75 to 125	136	136	4	2½	4	2½	1	1½	
7	6	6	12	1.47	1.47	75 to 125	294	294	5	4	5	4	1½	2	
8	8	8	12	2.61	2.61	75 to 125	522	522	6	5	6	5	1½	2	
9	8	9	12	2.61	3.30	75 to 125	522	660	6	5	8	7	2	2½	
10	9	10	12	3.30	4.08	75 to 125	660	816	8	7	8	7	2	2½	
12	10	12	12	4.08	5.87	75 to 125	816	1174	8	7	10	8	2½	3	
14	12	14	12	5.87	8.00	75 to 125	1174	1600	10	8	12	10	3	4	

Any other size or combination made to order.

SURFACE CONDENSER, COMBINED WITH DUPLEX AIR- AND CIRCULATING-PUMPS.



SURFACE CONDENSER, AIR-, AND CIRCULATING-PUMP COMBINED.

The illustration on the opposite page gives a general idea of the arrangement of surface condenser, air-, and circulating-pumps commonly supplied stationary steam-plants. Modifications may be made for use on shipboard, if the illustration lacks in compactness or any other quality.

The condenser can be made of either iron or brass, suited to the requirements of any particular case. The tubes will be seamless drawn, passing through brass tube-heads bored to fit the tubing, counterbored for the packing, and tapped to admit a threaded brass ferrule, thus securing a tight joint with ample provision for the expansion and contraction of tubes incident to a varying temperature.

The circulating pumps are the duplex double-acting reciprocating type, fitted with rubber valves for cold water. The air-pumps are of the same type as the circulating-pumps, except that the valves are of a material suited to boiling water. The air-pump supply is taken from underneath the condenser, and flows into the pump.

The steam-cylinders for the combined circulating- and air-pumps will be made of any suitable diameter.

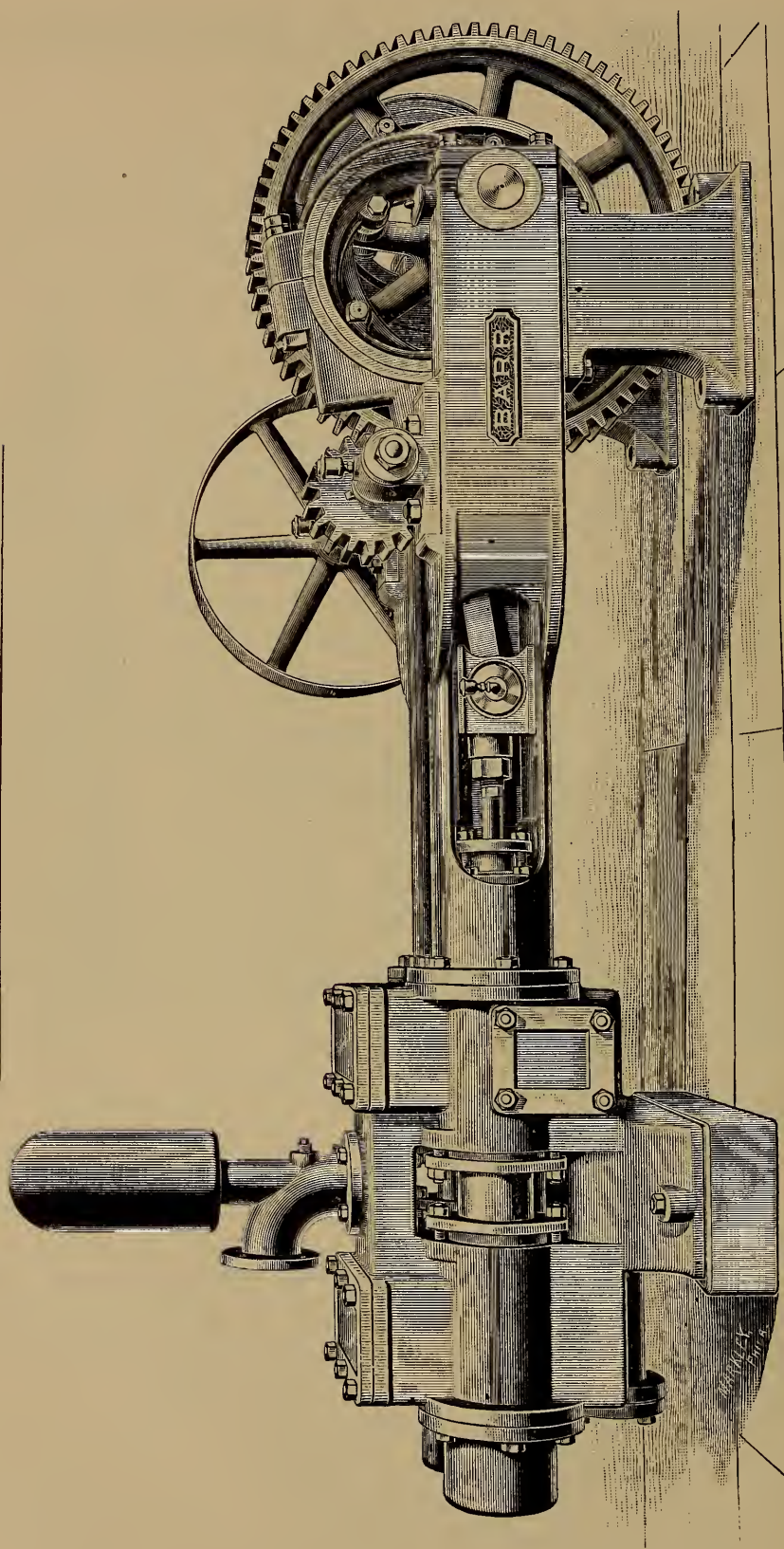
Boiler feed-pumps can be fitted to the ends of piston-rods of the air-pumps, if so desired, so that the flow of water of condensation from the condenser to the boiler shall be a continuous operation. A small hot-well should be provided in such a case, a device which is not shown in the engraving.

SURFACE CONDENSERS.

We are prepared to furnish surface condensers in any size, either with or without the combination of air- and circulating-pumps. We shall be pleased to receive from correspondents the data necessary for us to prepare designs and proposals for work of this nature.

We refer to page 73 as containing a list of sizes of combined duplex air- and circulating-pumps, also a list of air- and boiler feed-pumps, and to page 69 for a list of sizes of air- or vacuum-pumps, to be used when other sources of supply are had for the circulation of the water through the condenser.

DUPLEX GEARED POWER-PUMP.



Size, 5 x 10.

DUPLEX GEARED POWER-PUMPS, WITH CENTRALLY-PACKED PLUNGERS.

The smaller sizes are well adapted for feeding steam-boilers, house service, etc.

The larger sizes are suitable for handling large quantities of water at either high or low pressures. The packed plungers are fitted with outside stuffing-boxes, which can be adjusted without stopping the pump.

The ratio of gearing can be changed to suit any required conditions of service.

This list of pumps is for any service not exceeding 150 pounds per square inch, but they can be adapted to any pressure suitable for elevators, accumulator service, etc.

Combined with an electric motor, this type of pump is well adapted for mines and other localities where steam pumps cannot be used with advantage.

Piston or Plunger.		Gallons Delivered each Revolution of Crank-Shaft.	Revolutions per Minute.	Gallons per Minute Delivered by Both Plungers at Stated Number of Revolutions of Crank-Shaft.	Horse-Power Required at stated Number of Revolutions for a Pressure of 100 Pounds per Sq. Inch, with 20 per cent. added for Various Losses.	Size and Speed of Driving-Pulley Recommended.			Diameter of Pipes.		PRICE.*
Diameter.	Stroke.					Diameter.	Face.	Revolutions per Minute.	Suction.	Discharge.	
2½	6	.48	30 to 40	14 to 19	1 to 1½	14	4	120 to 160	1½	1¼	
3	8	.96	30 to 40	28 to 38	2 to 3	18	4	120 to 160	2	1½	
4	10	2.16	25 to 40	54 to 86	4 to 6	22	4	100 to 160	3	2	
5	10	3.40	25 to 40	85 to 136	6 to 10	24	4	100 to 160	4	3	
5¼	12	4.48	20 to 40	89 to 179	6 to 12	28	6	80 to 160	4	3	
6	12	5.88	20 to 40	117 to 235	8 to 16	30	7	80 to 160	5	4	
7	12	8.00	20 to 40	160 to 320	11 to 22	34	7	80 to 160	6	5	
8	12	10.44	20 to 40	208 to 416	15 to 30	36	8	80 to 160	6	5	
10	12	16.32	20 to 40	326 to 652	23 to 46	42	12	80 to 160	8	7	
12	12	23.48	20 to 40	469 to 939	33 to 66	48	14	80 to 160	10	8	

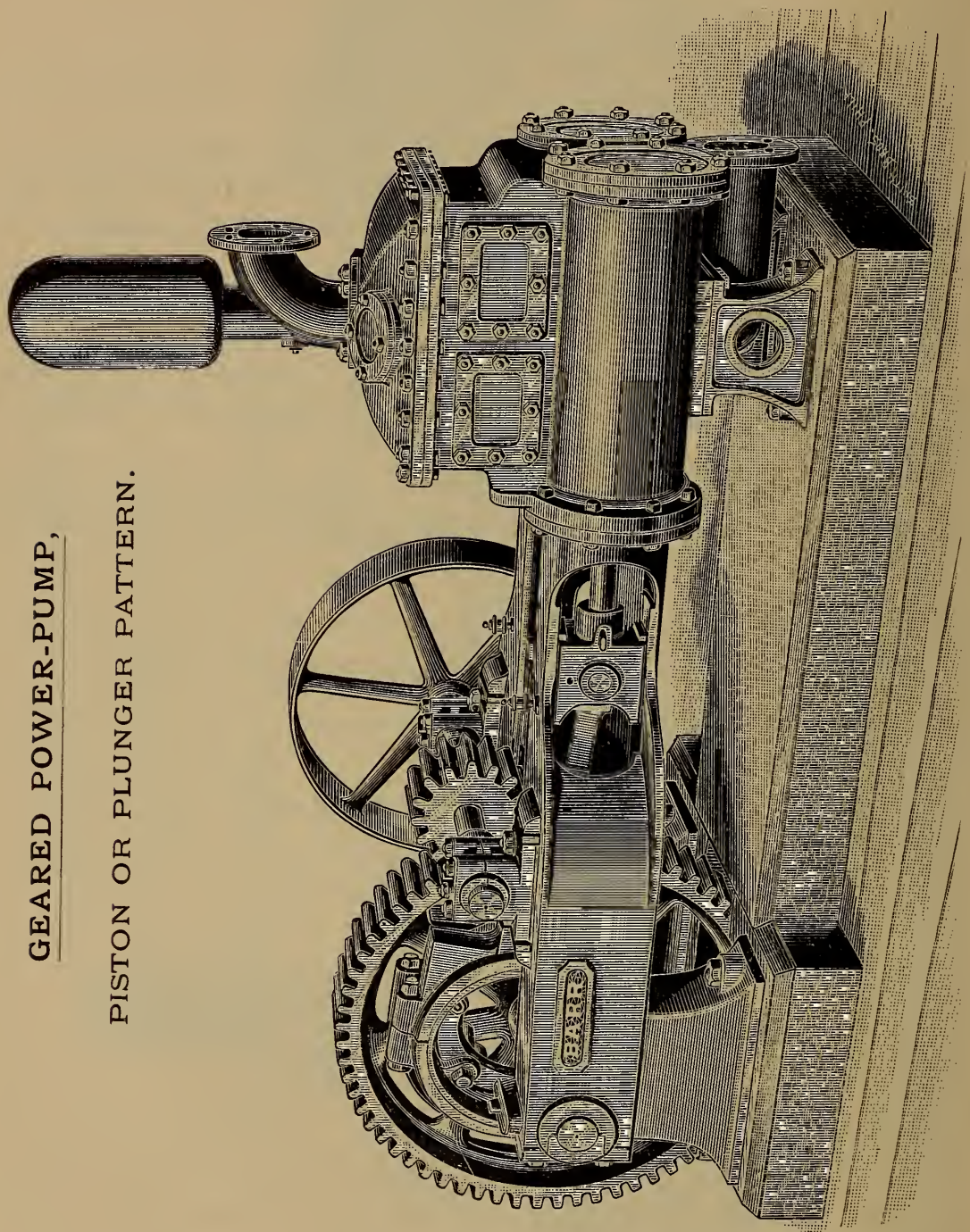
* Price does not include the driving-pulley, but the end of the shaft will be extended sufficiently for any suitable connection.

An extra charge will be made for bed-plates. Pumps can be brass fitted at a slight advance over the regular price given above.

Designs and estimates for sizes not contained in the above table will be promptly furnished upon receipt of the necessary data.

GEARED POWER-PUMP,

PISTON OR PLUNGER PATTERN.



DUPLEX GEARED POWER-PUMPS.

The pump shown on the opposite page will be supplied with either plungers or pistons, to best meet the requirements of a purchaser. The general construction of the water-end does not materially differ from that of our regular duplex steam pumps.

Valves will be furnished for either hot or cold water, and suited to any required pressure.

The gearing will be arranged for any water-pressure up to 150 pounds per square inch. All working joints are unusually large and made adjustable for wear. The problem of handling water under a high pressure, with cranks at right angles, is an altogether different one from that which obtains in ordinary duplex pumps, so that power pumps require not only to be heavier and stronger, but also require to run at a lower rate of speed than usually obtains in the use of duplex steam pumps.

These pumps are designed for use in connection with water-wheels, electric-motors, line-shafting, gas-engines, etc. The jack-shaft can be arranged for the use of a pulley, a coupling, friction clutch, or any other driving mechanism that will be most convenient.

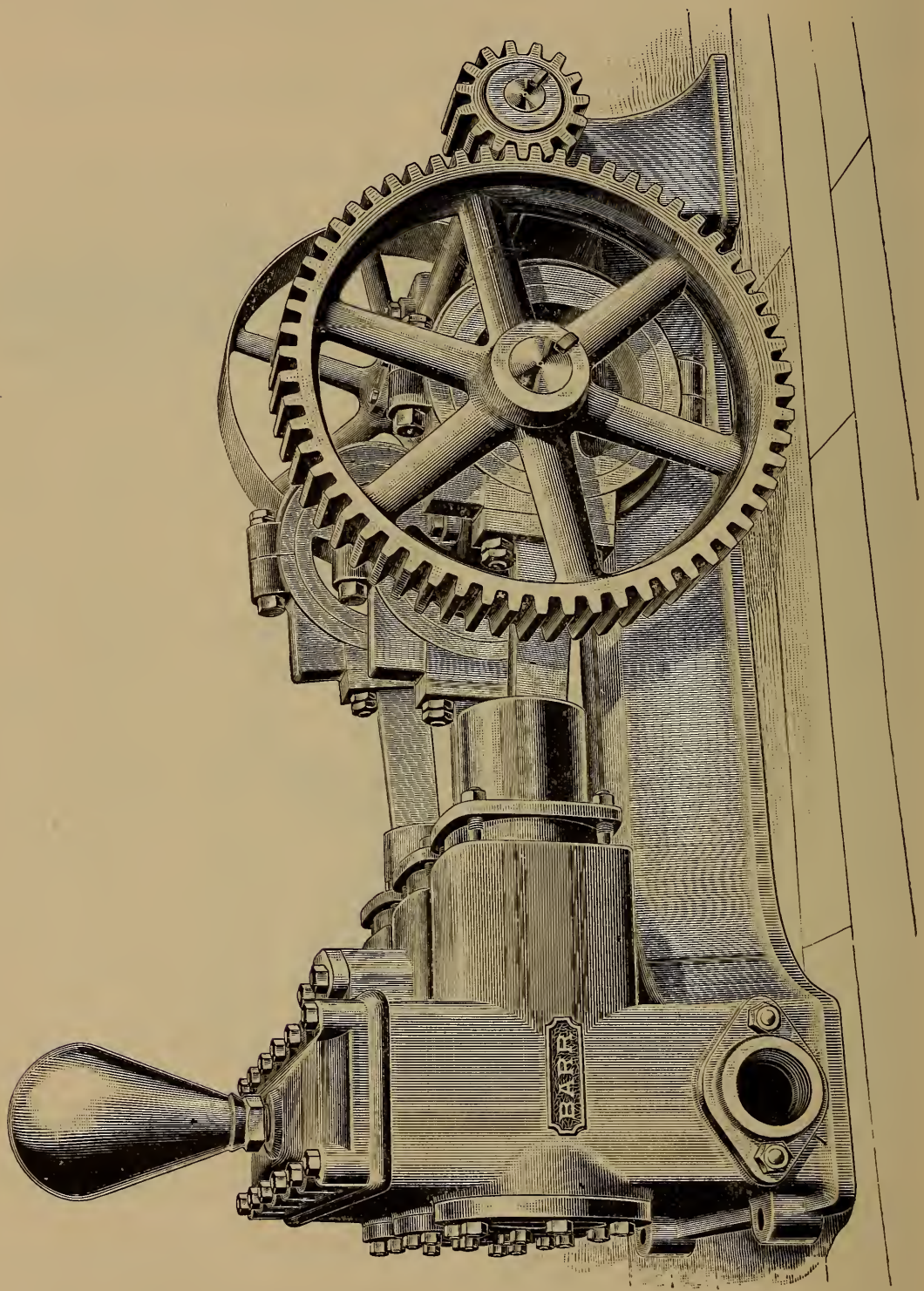
Piston or Plunger.		Gallons Delivered each Revolution of Crank-Shaft.	Revolutions per Minute.	Gallons per Minute Delivered by Both Plungers at Stated Number of Revolutions of Crank-Shaft.	Horse-Power Required at Stated Number of Revolutions for a Pressure of 100 Pounds per Sq. Inch, with 20 per cent. added for Various Losses.	Size and Speed of Driving-Pulley Recommended.			Diameter of Pipes.		PRICE.*
Diameter.	Stroke.					Diameter.	Face.	Revolutions per Minute.	Suction.	Discharge.	
2½	6	.48	30 to 40	14 to 19	1 to 1½	14	4	120 to 160	1½	1¼	
3¼	6	.84	30 to 40	25 to 33	2 to 2½	16	4	120 to 160	2	1½	
4	8	1.72	30 to 40	51 to 68	3½ to 5	18	4	120 to 160	3	2	
5	10	3.40	25 to 40	85 to 136	6 to 10	24	4	100 to 160	4	3	
6	12	5.88	20 to 40	117 to 235	8 to 16	30	7	80 to 160	5	4	
7	12	8.00	20 to 40	160 to 320	11 to 22	34	7	80 to 160	6	5	
8	12	10.44	20 to 40	208 to 416	15 to 30	36	8	80 to 160	6	5	
10	12	16.32	20 to 40	326 to 652	23 to 46	42	12	80 to 160	8	7	
12	12	23.48	20 to 40	469 to 939	33 to 66	48	14	80 to 160	10	8	
14	18	48.00	20 to 30	960 to 1440	67 to 100						
16	18	62.60	20 to 30	1252 to 1878	86 to 130						
18	18	79.00	20 to 30	1580 to 2370	110 to 166						

* Price does not include the driving-pulley, but the end of the shaft will be extended sufficiently for any suitable connection.

An extra charge will be made for bed-plates. Pumps can be brass fitted at a slight advance over the regular price given above.

Designs and estimates for sizes not contained in the above table will be promptly furnished upon receipt of the necessary data.

THREE-THROW SINGLE-ACTING GEARED POWER-PUMP.



Capacity, two gallons per revolution.

THE ELECTRICAL-PUMP.

This pump is designed for use with an electric motor. The water-end is fitted with three single-acting plungers with outside stuffing-boxes, which can be adjusted whilst the pump is in motion. The angular advance of each plunger is 120°, so that a practically continuous stream is had at the delivery.

The ratio of gearing is usually 4 to 1, but any other proportion can be provided for special work.

Each pump is provided with a heavy cast-iron bed-plate, which includes the bearings necessary for the shafts.

The gear and pinion are both cut so that their operation is noiseless.

The engraving shows a pulley attached to a pinion-shaft, by which a belt, leading from the electric motor, gives the pump its necessary motion; a gear can be fitted instead, and thus be driven by the motor direct, should it be deemed a preferable arrangement.

These pumps are suitable for any service where the water-pressure does not exceed 150 pounds per square inch.

Gallons for One Revolution.	Size of Plungers.		Gallons Delivered when making 40 to 80 Revolutions per Minute.	Gallons at Average Revolutions.	Size of Pulley.	Suction.	Discharge.	PRICE.*
	Diameter.	Stroke.						
½	3⅝	4	20 to 40	30	16 x 4	2	1	
1	4½	5	40 to 80	60	18 x 4	3	2	
2	5⅞	6	80 to 160	120	24 x 5	4	3	
3	6½	8	120 to 240	180	30 x 5	5	4	
4	7	8	160 to 320	240	32 x 6	6	4	

* Price does not include the driving-pulley, but the end of the shaft will be extended sufficiently for any suitable connection.

Pumps can be brass-fitted at a slight advance over the regular price given above.

Designs and estimates for sizes not contained in the above table will be promptly furnished upon receipt of the necessary data.

DUPLEX PRESSURE PUMPS.

The several pressure pumps listed in the accompanying tables are thought to cover every ordinary want so far as regards sizes for water-pressure, capacity, steam-pressure, and length of stroke. Notwithstanding the unusual number of sizes given in the accompanying tables, there are likely to be still others required in actual service. We desire to say that we are ready at all times to make designs and prepare specifications for pumping machinery suited to the special needs of our correspondents.

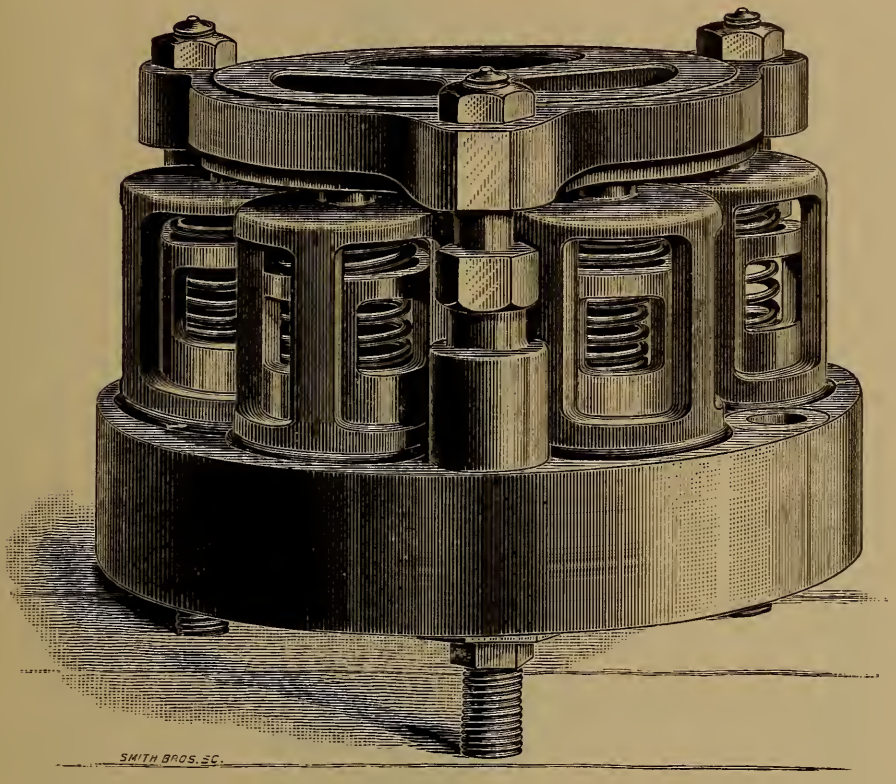
The pressure pumps included in this catalogue are intended to cover the ordinary requirements for steel-works, hydraulic lifts and cranes, accumulator service, oil-pipe lines, cotton-seed oil-works, etc. All pumps will be good for 500 pounds per square inch, and from that to any pressure that may be required; the smaller diameters can be fitted for pressures ranging from 1000 to 5000 pounds per square inch, or more, if desired. Correspondents will please give us full information regarding the work to be done, that a proper selection of design may be made suited to the work.

These pumps are all fitted with double-acting plungers, working through stuffing-boxes at each end of the pump-barrels; parallel-rods couple the outside plungers to the cross-head in the centre, to which are also secured both the inside plungers and the steam piston-rods. The stuffing-boxes are quite deep, so that a liberal quantity of packing can be inserted at one time. The stuffing-box glands can be adjusted while the pump is in motion.

For the smaller and medium sizes the water-ends are cast with a central partition separating the two working-ends of the barrel. For the largest sizes each end is cast separately and arranged for the insertion of a blank flange between the two ends of each working-barrel on each side, as shown on page 92.

The valves and seats in this style of pump, being subject to high pressures, receive special attention; both form and material are selected with reference to the highest efficiency in the most difficult service. All valves are easily accessible for examination, and both the valves and the valve-seats are removable, a convenient arrangement in case of repair or renewal.

We are prepared to make pressure pump water-ends of cast iron, open-hearth steel, or phosphor bronze, to meet the requirements of any service.

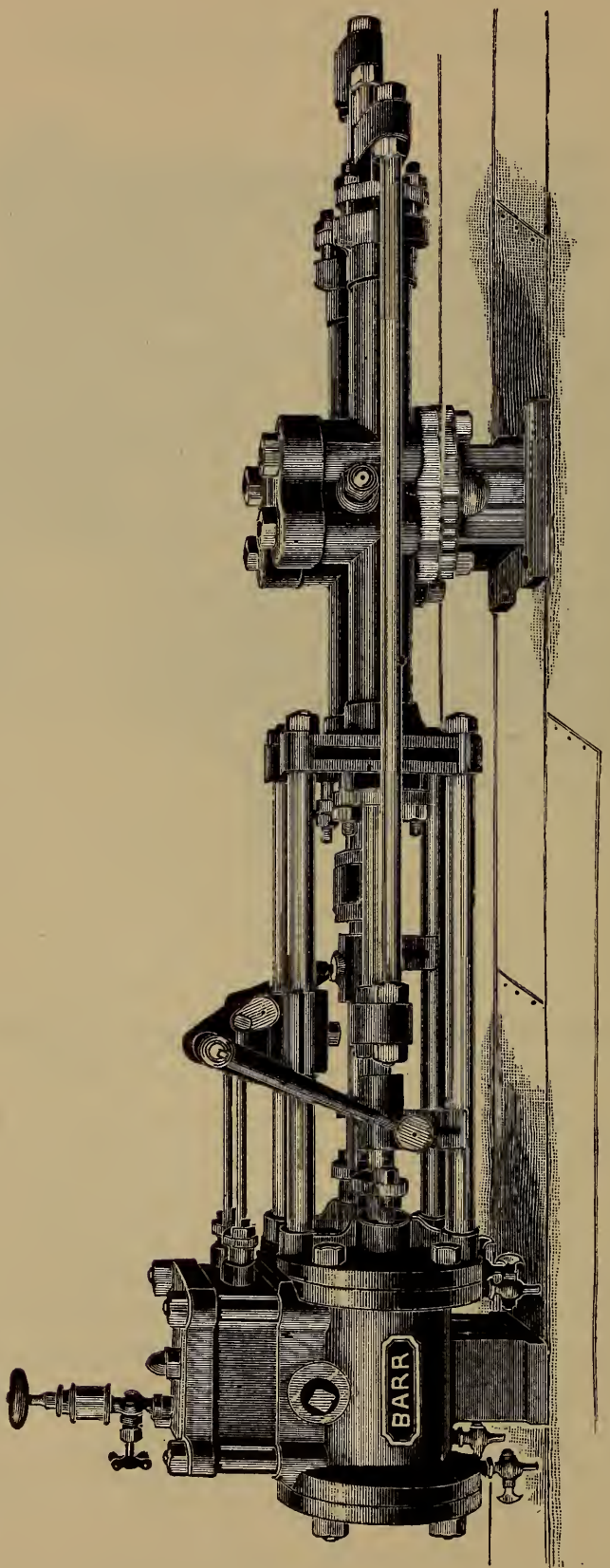


REMOVABLE VALVES AND SEATS.

The illustration given above represents one of the valve-seats and nest of valves contained in the pot-valve chambers of a 9″ x 36″ pressure-pump water-end, shown on page 92. All of our pot-valve chambers have removable seats and valves, the design being arranged according to the quantity of water to be pumped and the pressure in ordinary service. This arrangement permits the removal of one set of valves and the substitution of another without stopping the pump but a few minutes when making the change. As all the pot-valve chambers belonging to the pump are bored out to gauge, there will be required but one extra set of valves and a seat for repairs to fit any quarter of the water-end of the pump.

The valves, springs, and seat will be made of gun-metal or phosphor-bronze, as may best be suited to the work to be done.

DUPLEX PRESSURE PUMP.



Size, 6 x 1½ x 8.

PRESSURE PUMPS LESS THAN 12 INCHES STROKE.

These pumps are specially fitted for heavy pressures. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod respectively. This movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known; and, as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke; consequently, the pump can be started at any time with absolute certainty. The water-ends have outside connected double-acting plungers, with external adjustable stuffing-box glands. The valves and seats are carefully designed for the work required of them. The delivery of water is at all times constant and uniform.

These pumps can be made suitable to any pressure from 500 to 5000 pounds.

Ratio Steam to Water.	Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Cubic Inches for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Cubic Inches Delivered by Both Plungers at Stated Number of Strokes per Minute.	Water Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
							Cubic Inches.	Gallons.	Steam.	Exhaust.	Suction.	Discharge.	
25 to 1	5	1	6	4.7	30 to 90	282 to 846	564	2.4	1	1¼	¾	½	
16 to 1	5	1¼	6	7.4	30 to 90	444 to 1332	888	3.8	1	1¼	1	¾	
11.1 to 1	5	1½	6	10.6	30 to 90	636 to 1908	1272	5.5	1	1¼	1¼	¾	
6.25 to 1	5	2	6	18.8	30 to 90	1128 to 3384	2256	9.7	1	1¼	1½	1	
36 to 1	6	1	8	6.2	30 to 80	372 to 992	682	2.9	1	1½	1	¾	
16 to 1	6	1½	8	14.1	30 to 80	846 to 2256	1551	6.7	1	1½	1½	1	
9 to 1	6	2	8	25.1	30 to 80	1506 to 4016	2761	11.9	1	1½	2	1¼	
5.76 to 1	6	2½	8	39.3	30 to 80	2358 to 6288	4323	18.7	1	1½	2	1¼	
4 to 1	6	3	8	56.6	30 to 80	3396 to 9056	6226	28.7	1	1½	2½	1½	
64 to 1	8	1	10	7.8	30 to 70	468 to 1092	780	3.4	1½	2	1	¾	
28.44 to 1	8	1½	10	17.7	30 to 70	1062 to 2478	1770	7.7	1½	2	1½	1	
16 to 1	8	2	10	31.4	30 to 70	1884 to 4396	3141	13.6	1½	2	2	1¼	
10.24 to 1	8	2½	10	49.1	30 to 70	2946 to 6874	4910	21.2	1½	2	2	1¼	
7.11 to 1	8	3	10	70.7	30 to 70	4242 to 9898	7070	30.6	1½	2	2½	1½	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates.

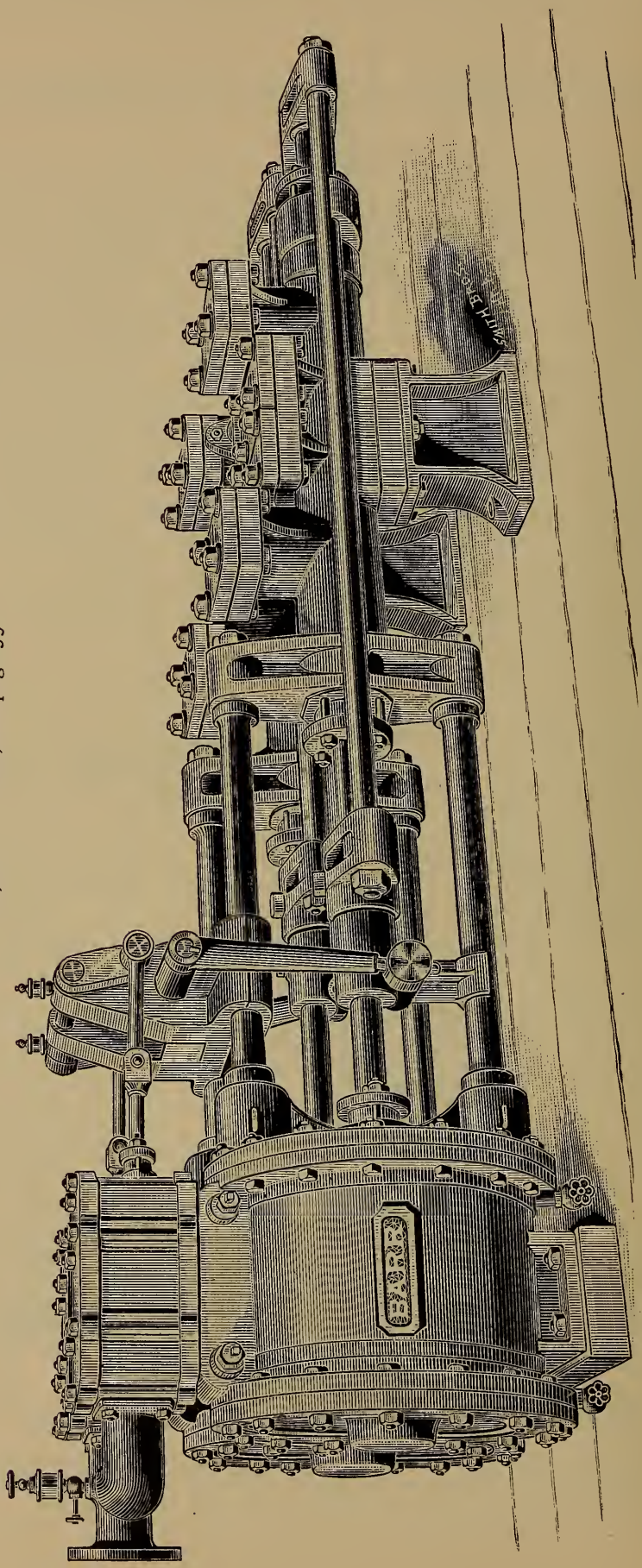
The larger sizes in the table can have the plungers made of brass at a slight advance over the ordinary prices.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 5 x 1 x 6 for the first pump in the table, and similarly for any other size.

DUPLEX PRESSURE PUMP.

These pumps can be fitted with compound steam-ends, as illustrated on page 54.

For list of sizes, see page 55.



Size, 22 x 3 x 12.

PRESSURE PUMPS OF 12 INCHES STROKE.

These pumps are specially fitted for heavy pressures. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod respectively. This movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known; and, as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke; consequently, the pump can be started at any time with absolute certainty. The water-ends have outside connected double-acting plungers, with external adjustable stuffing-box glands. The valves and seats are carefully designed for the work required of them. The delivery of water is at all times constant and uniform.

These pumps can be made suitable for any pressure from 500 to 2500 pounds.

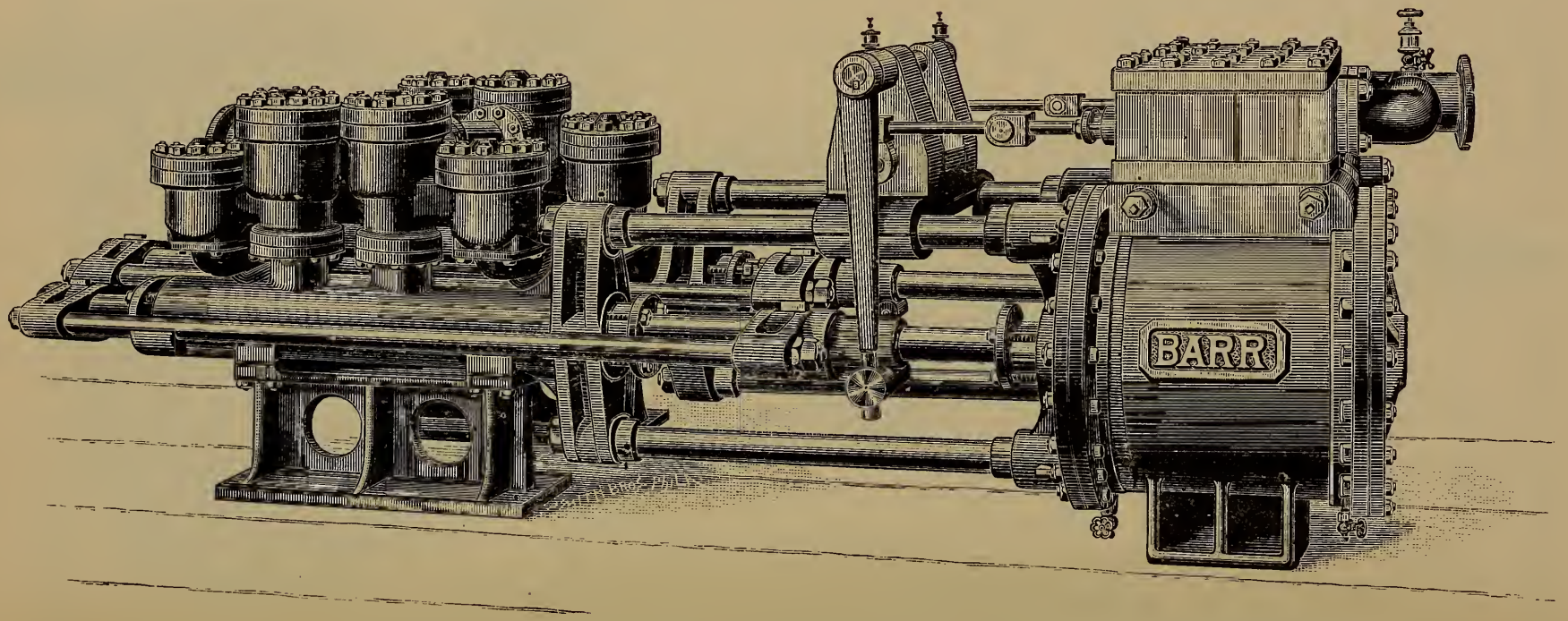
Ratio Steam to Water.	Diameter of Steam-Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Displacement in Cubic Inches for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Cubic Inches delivered by Both Plungers at Stated Number of Strokes per Minute.	Water Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
							Cubic Inches.	Gallons.	Steam.	Exhaust.	Suction.	Discharge.	
144 to 1	12	1	12	9.4	25 to 70	470 to 1,316	893	3.9	2½	3	1	¾	
64 to 1	12	1½	12	21.2	25 to 70	1,060 to 2,968	2,014	8.7	2½	3	1½	1	
36 to 1	12	2	12	37.7	25 to 70	1,885 to 5,278	3,581	15.5	2½	3	2	1¼	
23 to 1	12	2½	12	58.9	25 to 70	2,945 to 8,246	5,595	24.2	2½	3	2	1¼	
16 to 1	12	3	12	84.8	25 to 70	4,240 to 11,872	8,056	34.9	2½	3	2½	1½	
11.7 to 1	12	3½	12	115.4	25 to 70	5,770 to 16,156	10,963	47.5	2½	3	2½	2	
9 to 1	12	4	12	150.8	25 to 70	7,540 to 21,112	14,326	62.0	2½	3	3	2	
49 to 1	14	2	12	37.7	25 to 70	1,885 to 5,278	3,581	15.5	3	4	2	1¼	
31.3 to 1	14	2½	12	58.9	25 to 70	2,945 to 8,246	5,595	24.2	3	4	2	1¼	
21.7 to 1	14	3	12	84.8	25 to 70	4,240 to 11,872	8,056	34.9	3	4	2½	1½	
16 to 1	14	3½	12	115.4	25 to 70	5,770 to 16,156	10,963	47.5	3	4	2½	2	
12.2 to 1	14	4	12	150.8	25 to 70	7,540 to 21,112	14,326	62.0	3	4	3	2	
9.6 to 1	14	4½	12	190.8	25 to 70	9,540 to 26,712	18,126	78.5	3	4	4	2½	
7.8 to 1	14	5	12	235.6	25 to 70	11,780 to 32,984	22,382	96.9	3	4	4	2½	
28.4 to 1	16	3	12	84.8	25 to 70	4,240 to 11,872	8,056	34.9	3	4	2½	1½	
20.9 to 1	16	3½	12	115.4	25 to 70	5,770 to 16,156	10,963	47.5	3	4	2½	2	
16 to 1	16	4	12	150.8	25 to 70	7,540 to 21,112	14,326	62.0	3	4	3	2	
12.6 to 1	16	4½	12	190 8	25 to 70	9.540 to 26,712	18,126	78.5	3	4	4	2½	
10.2 to 1	16	5	12	235.6	25 to 70	11,780 to 32,984	22,382	96.9	3	4	4	2½	
8.4 to 1	16	5½	12	285.1	25 to 70	14,255 to 39,914	27,084	117.2	3	4	5	3	
7.1 to 1	16	6	12	339.3	25 to 70	16,965 to 47,502	32,233	139.5	3	4	5	3	
36 to 1	18	3	12	84.8	25 to 70	4,240 to 11,872	8,056	34.9	3½	5	2½	1½	
26.4 to 1	18	3½	12	115.4	25 to 70	5,770 to 16,156	10,963	47.5	3½	5	2½	2	
20.2 to 1	18	4	12	150.8	25 to 70	7,540 to 21,112	14,326	62.0	3½	5	3	2	
16 to 1	18	4½	12	190.8	25 to 70	9,540 to 26,712	18,126	78.5	3½	5	4	2½	
12.9 to 1	18	5	12	235.6	25 to 70	11,780 to 32,984	22,382	96.9	3½	5	4	2½	
10.7 to 1	18	5½	12	285.1	25 to 70	14,255 to 39,914	27,084	117.2	3½	5	5	3	
9 to 1	18	6	12	339.3	25 to 70	16,965 to 47,502	32,233	139.5	3½	5	5	3	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

DUPLEX PRESSURE PUMP, WITH POT-VALVE CHAMBERS.

These pumps can be fitted with compound steam-ends, as illustrated on pages 54 and 56.

For list of sizes, see pages 55 and 57.



Size, 26 x 4½ x 18.

PRESSURE PUMPS OF 18 INCHES STROKE.

These pumps are specially fitted for heavy pressures. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod respectively. This movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known; and, as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke; consequently, the pump can be started at any time with absolute certainty. The water-ends have outside connected double-acting plungers, with external adjustable stuffing-box glands. The valve and seats are carefully designed for the work required of them. The delivery of water is at all times constant and uniform.

These pumps can be made suitable for any pressure from 500 to 2500 pounds.

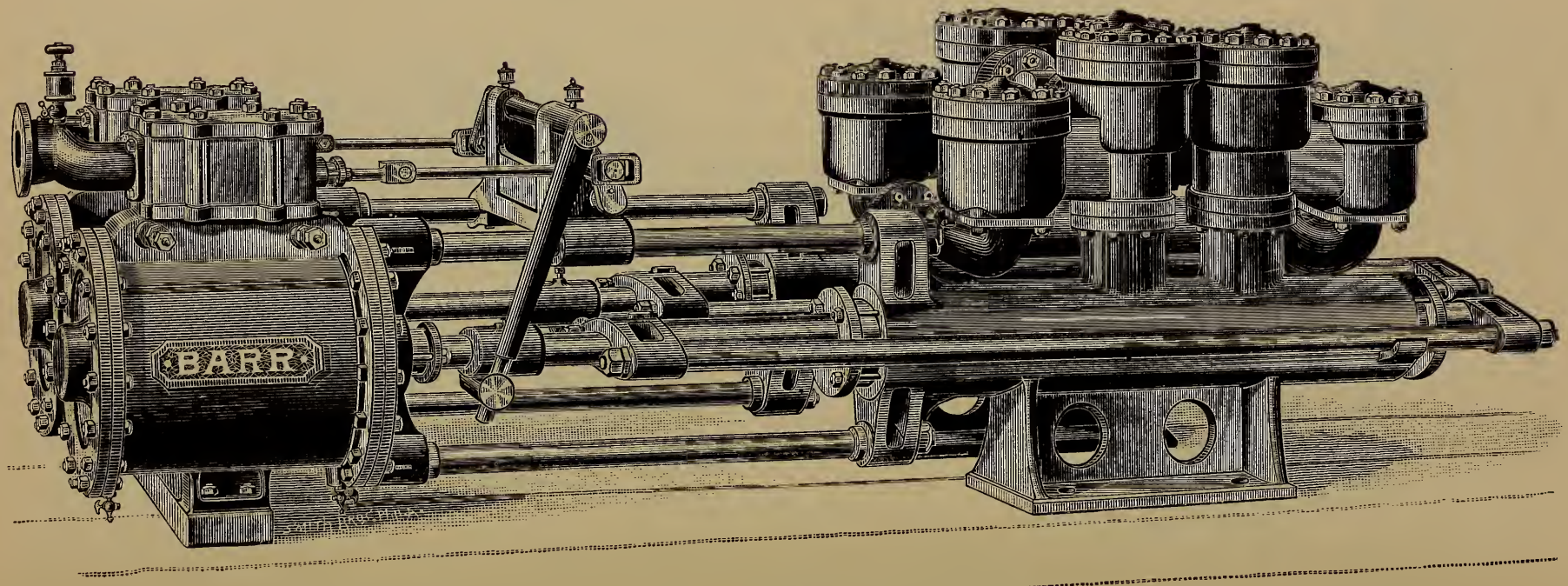
Ratio Steam to Water.	Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.	Diameter of Pipes in Inches.				PRICE.
								Steam.	Exhaust.	Suction.	Discharge.	
20.2 to 1	18	4	18	.98	20 to 65	39 to 127	83	3½	5	3	2	
16 to 1	18	4½	18	1.24	20 to 65	49 to 161	105	3½	5	4	2½	
12.9 to 1	18	5	18	1.53	20 to 65	61 to 199	130	3½	5	4	2½	
10.7 to 1	18	5½	18	1.85	20 to 65	74 to 240	157	3½	5	5	3	
9 to 1	18	6	18	2.20	20 to 65	88 to 286	187	3½	5	5	3	
7 7 to 1	18	6½	18	2.58	20 to 65	103 to 335	219	3½	5	5	3	
6.6 to 1	18	7	18	2.99	20 to 65	120 to 389	254	3½	5	6	4	
25 to 1	20	4	18	.98	20 to 65	39 to 127	83	3½	5	3	2	
19.7 to 1	20	4½	18	1.24	20 to 65	49 to 161	105	3½	5	4	2½	
16 to 1	20	5	18	1.53	20 to 65	61 to 199	130	3½	5	4	2½	
13.2 to 1	20	5½	18	1.85	20 to 65	74 to 240	157	3½	5	5	3	
11.1 to 1	20	6	18	2.20	20 to 65	88 to 286	187	3½	5	5	3	
9.4 to 1	20	6½	18	2.58	20 to 65	103 to 335	219	3½	5	5	3	
8.1 to 1	20	7	18	2.99	20 to 65	120 to 389	254	3½	5	6	4	
7.1 to 1	20	7½	18	3.44	20 to 65	138 to 447	292	3½	5	6	4	
6.2 to 1	20	8	18	3.91	20 to 65	156 to 508	332	3½	5	6	4	
30.2 to 1	22	4	18	.98	20 to 65	39 to 127	83	4	6	3	2	
23.9 to 1	22	4½	18	1.24	20 to 65	49 to 161	105	4	6	4	2½	
19.2 to 1	22	5	18	1.53	20 to 65	61 to 199	130	4	6	4	2½	
16 to 1	22	5½	18	1.85	20 to 65	74 to 240	157	4	6	5	3	
13.4 to 1	22	6	18	2.20	20 to 65	88 to 286	187	4	6	5	3	
11.4 to 1	22	6½	18	2.58	20 to 65	103 to 335	219	4	6	5	3	
9.8 to 1	22	7	18	2.99	20 to 65	120 to 389	254	4	6	6	4	
8.6 to 1	22	7½	18	3.44	20 to 65	138 to 447	292	4	6	6	4	
7.2 to 1	22	8	18	3.91	20 to 65	156 to 508	332	4	6	6	4	
36 to 1	24	4	18	.98	20 to 65	39 to 127	83	4	6	3	2	
28.4 to 1	24	4½	18	1.24	20 to 65	49 to 161	105	4	6	4	2½	
23 to 1	24	5	18	1.53	20 to 65	61 to 199	130	4	6	4	2½	
19 to 1	24	5½	18	1.85	20 to 65	74 to 240	157	4	6	5	3	
16 to 1	24	6	18	2.20	20 to 65	88 to 286	187	4	6	5	3	
13.6 to 1	24	6½	18	2.58	20 to 65	103 to 335	219	4	6	5	3	
11.7 to 1	24	7	18	2.99	20 to 65	120 to 389	254	4	6	6	4	
10.2 to 1	24	7½	18	3.44	20 to 65	138 to 447	292	4	6	6	4	
9 to 1	24	8	18	3.91	20 to 65	156 to 508	332	4	6	6	4	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

DUPLEX PRESSURE PUMP, WITH POT-VALVE CHAMBERS.

These pumps can be fitted with compound steam-ends, as illustrated on page 56.

For list of sizes, see page 57.



Size, 20 x 6 x 24.

PRESSURE PUMPS OF 24 INCHES STROKE.

These pumps are specially fitted for heavy pressures. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod respectively. This movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known; and, as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke; consequently, the pump can be started at any time with absolute certainty. The water-ends have outside connected double-acting plungers, with external adjustable stuffing-box glands. The valves and seats are carefully designed for the work required of them. The delivery of water is at all times constant and uniform.

These pumps can be made suitable for any pressure from 500 to 2500 pounds.

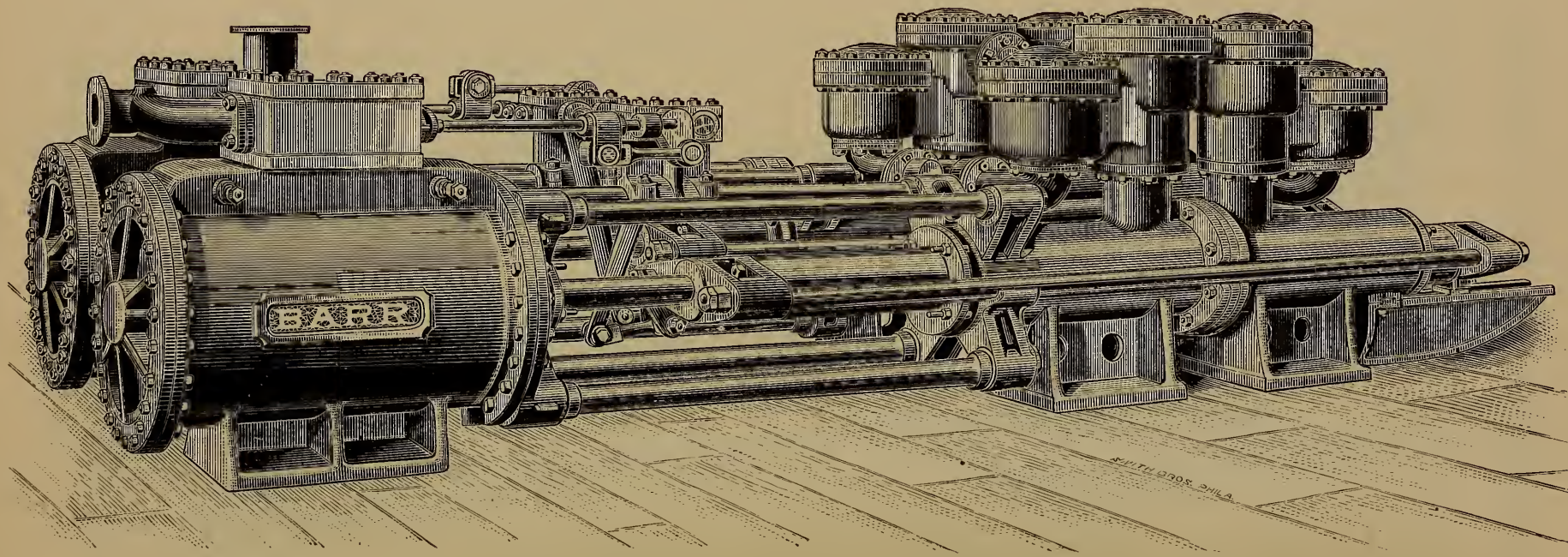
Ratio Steam to Water.	Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.	Diameter of Pipes in Inches.				PRICE.
								Steam.	Exhaust.	Suction.	Discharge.	
36.0 to 1	24	4	24	1.30	20 to 60	52 to 156	104	4	6	3	2	
23.0 to 1	24	5	24	2.04	20 to 60	82 to 245	163	4	6	4	2½	
16.0 to 1	24	6	24	2.93	20 to 60	117 to 352	234	4	6	5	3	
11.7 to 1	24	7	24	3.99	20 to 60	160 to 479	319	4	6	6	4	
9.0 to 1	24	8	24	5.22	20 to 60	209 to 626	418	4	6	6	4	
7.1 to 1	24	9	24	6.60	20 to 60	264 to 792	528	4	6	7	5	
5.7 to 1	24	10	24	8.15	20 to 60	326 to 978	652	4	6	7	5	
18.7 to 1	26	6	24	2.93	20 to 60	117 to 352	234	5	7	5	3	
13.7 to 1	26	7	24	3.99	20 to 60	160 to 479	319	5	7	6	4	
10.5 to 1	26	8	24	5.22	20 to 60	209 to 626	418	5	7	6	4	
8.3 to 1	26	9	24	6.60	20 to 60	264 to 792	528	5	7	7	5	
7.4 to 1	26	10	24	8.15	20 to 60	326 to 978	652	5	7	7	5	
21.7 to 1	28	6	24	2.93	20 to 60	117 to 352	234	5	7	5	3	
16.0 to 1	28	7	24	3.99	20 to 60	160 to 479	319	5	7	6	4	
12.2 to 1	28	8	24	5.22	20 to 60	209 to 626	418	5	7	6	4	
9.6 to 1	28	9	24	6.60	20 to 60	264 to 792	528	5	7	7	5	
7.8 to 1	28	10	24	8.15	20 to 60	326 to 978	652	5	7	7	5	
6.4 to 1	28	11	24	9.86	20 to 60	394 to 1183	789	5	7	8	6	
5.4 to 1	28	12	24	11.74	20 to 60	470 to 1409	939	5	7	8	6	
25.0 to 1	30	6	24	2.93	20 to 60	117 to 352	234	6	8	5	3	
18.3 to 1	30	7	24	3.99	20 to 60	160 to 479	319	6	8	6	4	
14.0 to 1	30	8	24	5.22	20 to 60	209 to 626	418	6	8	6	4	
11.1 to 1	30	9	24	6.60	20 to 60	264 to 792	528	6	8	7	5	
9.0 to 1	30	10	24	8.15	20 to 60	326 to 978	652	6	8	7	5	
7.4 to 1	30	11	24	9.86	20 to 60	394 to 1183	789	6	8	8	6	
6.2 to 1	30	12	24	11.74	20 to 60	470 to 1409	939	6	8	8	6	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

DUPLEX PRESSURE PUMP, WITH POT-VALVE CHAMBERS.

These pumps can be fitted with compound steam-ends similar to the design shown on page 56.

Designs furnished for any required service.



Size, 26 x 9 x 36.

PRESSURE PUMPS OF 36 INCHES STROKE.

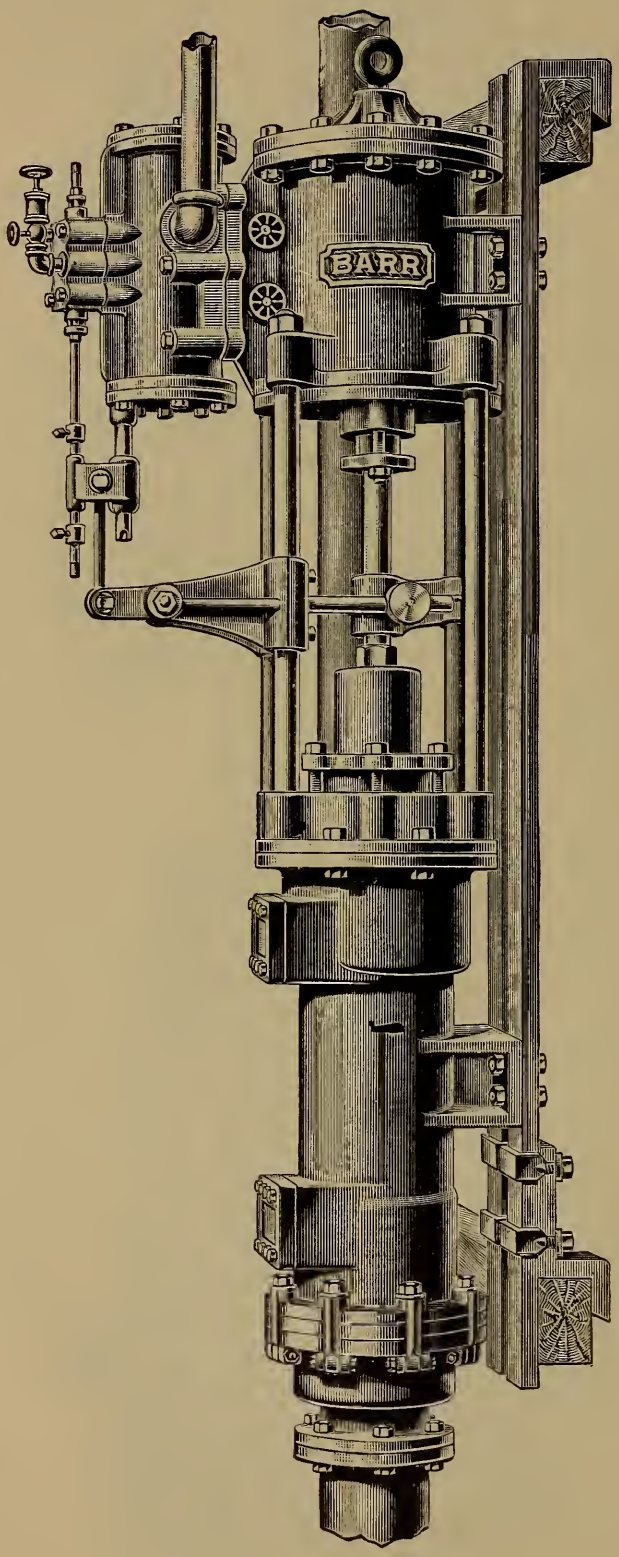
These pumps are specially fitted for heavy pressures. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod respectively. This movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known; and, as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke; consequently, the pump can be started at any time with absolute certainty. The water-ends have outside connected double-acting plungers, with external adjustable stuffing-box glands. The valves and seats are carefully designed for the work required of them. The delivery of water is at all times constant and uniform.

These pumps can be made suitable for any pressure from 500 to 1500 pounds.

Ratio Steam to Water.	Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.	Diameter of Pipes in Inches.				PRICE.
								Steam.	Exhaust.	Suction.	Discharge.	
18.7 to 1	26	6	36	4.41	20 to 50	176 to 441	308	5	7	5	3	
13.7 to 1	26	7	36	6.00	20 to 50	240 to 600	420	5	7	6	4	
10.5 to 1	26	8	36	7.84	20 to 50	314 to 784	549	5	7	6	4	
8.3 to 1	26	9	36	9.92	20 to 50	397 to 992	694	5	7	7	5	
6.7 to 1	26	10	36	12.25	20 to 50	490 to 1225	857	5	7	7	5	
5.5 to 1	26	11	36	14.82	20 to 50	593 to 1482	1037	5	7	8	6	
4.6 to 1	26	12	36	17.64	20 to 50	706 to 1764	1235	5	7	8	6	
12.2 to 1	28	8	36	7.84	20 to 50	314 to 784	549	5	7	6	4	
9.6 to 1	28	9	36	9.92	20 to 50	397 to 992	694	5	7	7	5	
7.8 to 1	28	10	36	12.25	20 to 50	490 to 1225	857	5	7	7	5	
6.4 to 1	28	11	36	14.82	20 to 50	593 to 1482	1037	5	7	8	6	
5.4 to 1	28	12	36	17.64	20 to 50	706 to 1764	1235	5	7	8	6	
14.0 to 1	30	8	36	7.84	20 to 50	314 to 784	549	6	8	6	4	
11.1 to 1	30	9	36	9.92	20 to 50	397 to 992	694	6	8	7	5	
9.0 to 1	30	10	36	12.25	20 to 50	490 to 1225	857	6	8	7	5	
7.4 to 1	30	11	36	14.82	20 to 50	593 to 1482	1037	6	8	8	6	
6.2 to 1	30	12	36	17.64	20 to 50	706 to 1764	1235	6	8	8	6	
16.0 to 1	32	8	36	7.84	20 to 50	314 to 784	549	6	8	6	4	
12.6 to 1	32	9	36	9.92	20 to 50	397 to 992	694	6	8	7	5	
10.2 to 1	32	10	36	12.25	20 to 50	490 to 1225	857	6	8	7	5	
8.4 to 1	32	11	36	14.82	20 to 50	593 to 1482	1037	6	8	8	6	
7.1 to 1	32	12	36	17.64	20 to 50	706 to 1764	1235	6	8	8	6	
18.0 to 1	34	8	36	7.84	20 to 50	314 to 784	549	8	10	6	4	
14.2 to 1	34	9	36	9.92	20 to 50	397 to 992	694	8	10	7	5	
11.5 to 1	34	10	36	12.25	20 to 50	490 to 1225	857	8	10	7	5	
9.5 to 1	34	11	36	14.82	20 to 50	593 to 1482	1037	8	10	8	6	
8.0 to 1	34	12	36	17.64	20 to 50	706 to 1764	1235	8	10	8	6	
20.2 to 1	36	8	36	7.84	20 to 50	314 to 784	549	8	10	6	4	
16.0 to 1	36	9	36	9.92	20 to 50	397 to 992	694	8	10	7	5	
12.9 to 1	36	10	36	12.25	20 to 50	490 to 1225	857	8	10	7	5	
10.7 to 1	36	11	36	14.82	20 to 50	593 to 1482	1037	8	10	8	6	
9.0 to 1	36	12	36	17.64	20 to 50	706 to 1764	1235	8	10	8	6	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

VERTICAL SINKING PUMP.



VERTICAL SINKING PUMPS.

The design on the opposite page represents a sinking pump of the double-acting bucket and plunger pattern, so arranged that the pump may be operated by suspending it from overhead, or it may be attached to the timbering in the mine.

This pump is very compact, occupying but little room in the shaft, is easily handled and under perfect control, requiring but little attendance.

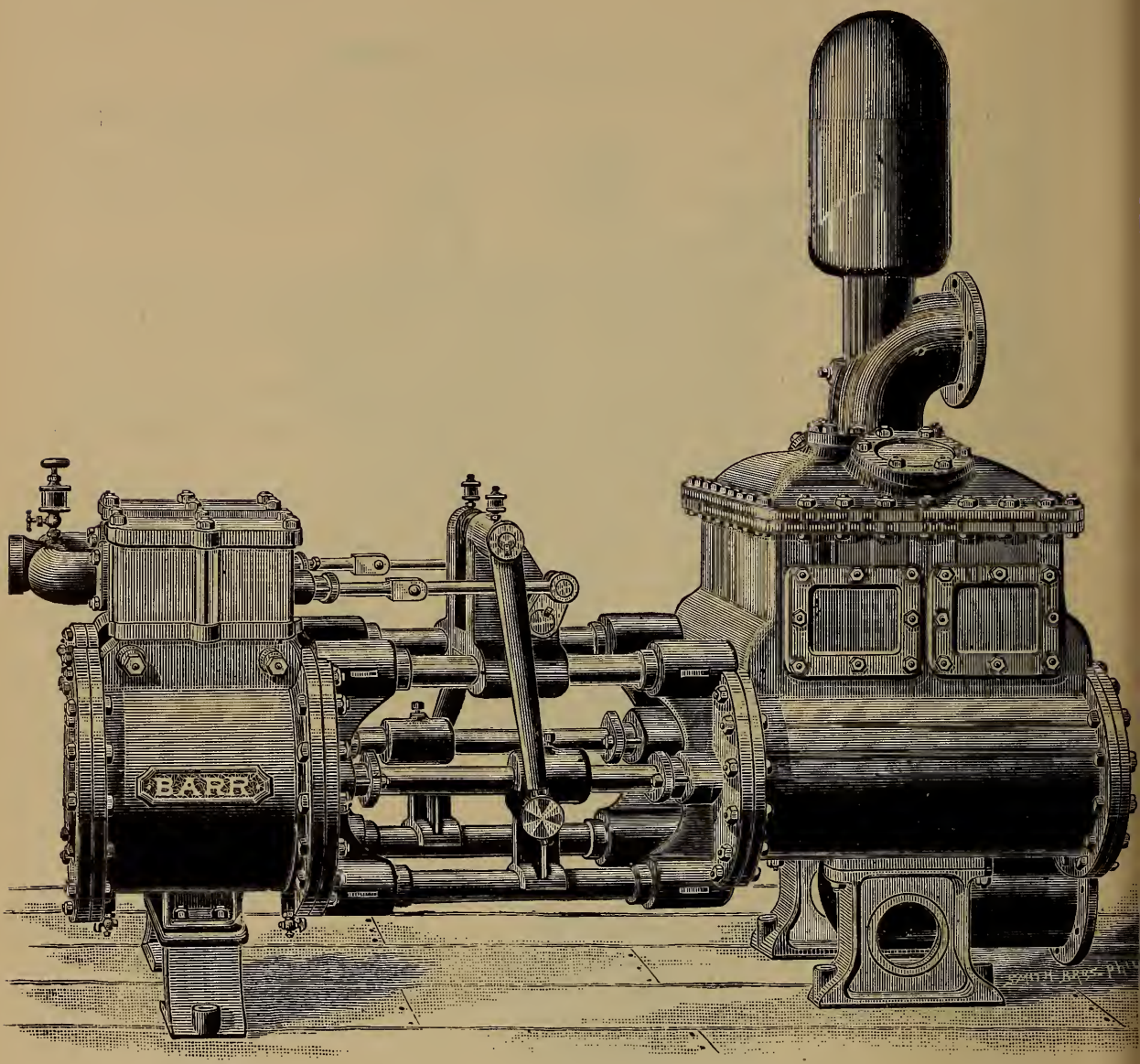
The relative size of the bucket and plunger is given in the table below; the proportions of the two are such as to give a continuous stream from the discharge.

The pump is fitted with a removable composition lining. The valves are easy of access; the movement of the steam-valve is positive, making it one of the most compact and desirable sinking pumps now offered.

There are no bends in the suction-pipe, which extends vertically downward from the bottom of the pump. The water-cylinder is so arranged that the discharge-pipe bolts to it with a horizontal flange, so that no turns or elbows are had in the discharge.

Diameter of Steam-Cylinders.	Diameter.		Stroke in Inches.	Displacement in Gallons per Stroke.	Gallons at 100 Feet Piston Speed.	Diameter of Pipes in Inches.				PRICE.
	Upper Plunger.	Lower Bucket.				Steam.	Exhaust.	Suction.	Discharge.	
8	5	7	12	1.02	102	1¼	1½	4	3	
9	5	7	12	1.02	102	1¼	2	4	3	
10	5	7	12	1.02	102	1¼	2	4	3	
9	6	8½	12	1.47	147	1¼	2	5	4	
10	6	8½	12	1.47	147	1¼	2	5	4	
12	6	8½	12	1.47	147	1½	2½	5	4	
12	7	10	18	3.00	300	1½	2½	6	5	
14	7	10	18	3.00	300	2	3	6	5	
14	8	11⅜	18	3.91	391	2	3	6	5	
16	8	11⅜	18	3.91	391	2	3	6	5	
16	10	14⅛	18	6.12	612	2	3	8	7	
18	10	14⅛	18	6.12	612	2½	3½	8	7	
20	10	14⅛	18	6.12	612	3	4	8	7	

Other Sizes and Combinations to Order.



DUPLEX MINE-PUMP.

PISTON PATTERN, WITH REMOVABLE LINING.

These pumps are extensively used in quarries, surface excavations, and mines where the depth does not exceed 250 feet. These pumps are fitted with removable gun-metal linings, so arranged that the linings may be partially turned in the water-cylinders to present a new or unworn surface underneath the piston. The detail of the lining is shown on page 14. The pistons are adapted for the use of Tuck's or other fibrous packing. Valves are specially selected for mine service.

These pumps can be fitted with compound steam-ends, as illustrated on page 54.
For list of sizes, see page 55.

DUPLEX MINE-PUMP.

PISTON PATTERN, WITH REMOVABLE LINING.

These pumps are specially adapted for mines where the water is free from acid but contains more or less gritty matter.

Each pump-barrel is furnished with a heavy gun-metal lining, held in place by bolts inside of the port line, so as to offer no obstruction to the flow of water.

These linings can be partially turned in place to present new wearing surfaces, and when completely worn can be easily removed and new ones substituted.

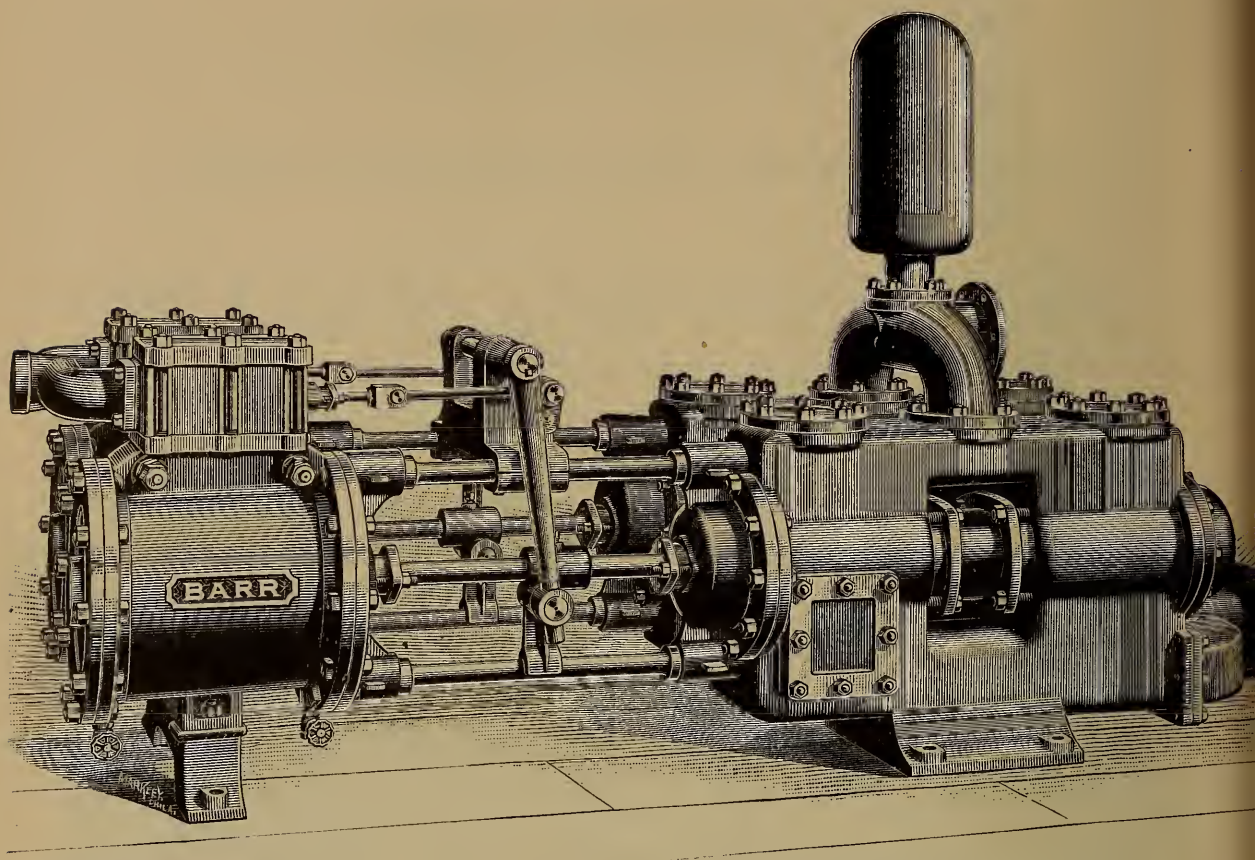
Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
8	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	1½	2	5	4	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	5	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	5	4	
10	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2	2½	6	5	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	6	5	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2	2½	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	2½	3	6	5	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	6	5	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke; thus, 8 x 6 x 12 for the first pump in the table, and similarly for any other size.

☞ The above pumps are designed for any service in which the water-pressure does not exceed 150 pounds per square inch.



Size, 14 x 7 x 12.

DUPLEX MINE-PUMP, WITH CENTRALLY-PACKED PLUNGERS.

The duplex mine-pump illustrated above is growing steadily in favor for the removal of water from mines. The steam-end is fitted with our well-known valve motion described on page 4.

The water-end of the pump is of the packed plunger type, with stuffing-boxes arranged in the centre of the pump. These stuffing-boxes are adapted for the use of any of the several forms of fibrous packing now offered in the market.

The plungers are ordinarily made of cast-iron; they are easily lubricated, and as these plungers never come in contact with any other portion of the pump, they are less liable to cutting or uneven wear when handling gritty water than ordinary plunger pumps.

These pumps are all double-acting, and, by reason of their compactness, very little space is occupied in the mine.

DUPLEX MINE-PUMPS OF 12 INCHES STROKE.

These pumps are of the centrally-packed plunger type, and especially adapted for mines, quarries, etc. As all the wear of the pump comes on the fibrous packing, which is easily renewable, their efficiency is easily and cheaply maintained.

These pumps are ordinarily built as shown on the opposite page. Whenever desired, we can furnish any of the sizes tabulated below with compound steam-ends, as illustrated on page 54.

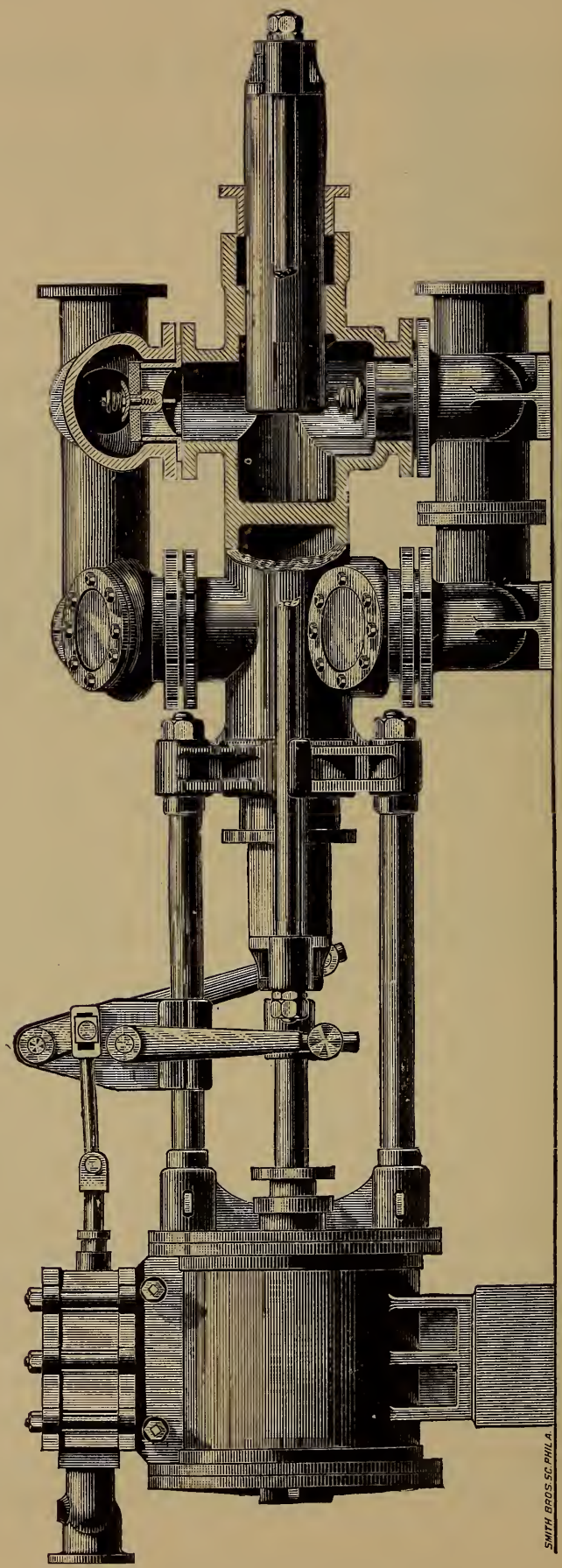
Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at 100 Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
8	4	12	.65	75 to 125	98 to 163	130	7,800	187,200	1½	2	4	4	
10	4	12	.65	75 to 125	98 to 163	130	7,800	187,200	2	2½	4	4	
12	4	12	.65	75 to 125	98 to 163	130	7,800	187,200	2½	3	4	4	
8	5	12	1.02	75 to 125	153 to 255	204	12,240	293,760	1½	2	5	4	
10	5	12	1.02	75 to 125	153 to 255	204	12,240	293,760	2	2½	5	4	
12	5	12	1.02	75 to 125	153 to 255	204	12,240	293,760	2½	3	5	4	
10	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2	2½	6	4	
12	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	2½	3	6	4	
14	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	3	4	6	4	
16	6	12	1.47	75 to 125	220 to 367	294	17,640	423,360	3	4	6	4	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	2½	3	7	6	
14	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	7	6	
16	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3	4	7	6	
18	7	12	2.00	75 to 125	300 to 500	400	24,000	576,000	3½	5	7	6	
14	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	8	6	
16	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3	4	8	6	
18	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3½	5	8	6	
20	8	12	2.61	75 to 125	391 to 652	522	31,320	751,680	3½	5	8	6	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
16	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3	4	8	7	
18	10	12	4 08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	
20	10	12	4.08	75 to 125	612 to 1020	816	48,960	1,175,040	3½	5	8	7	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 8 x 4 x 12 for the first pump in the table, and similarly for any other size.

DUPLEX MINE-PUMP 18 INCHES STROKE.



DUPLEX MINE-PUMPS OF 18 INCHES STROKE.

These pumps are designed for high lifts and for bad water. The plungers have end stuffing-boxes, as shown in the illustration on the opposite page. The water-end has been designed with special reference to renewal of parts, when used with acid water. All parts are made to gauges and strictly interchangeable.

Any of the sizes tabulated below can be fitted with compound steam-ends, as illustrated on pages 54 and 56.

For list of sizes of condensing apparatus see page 63.

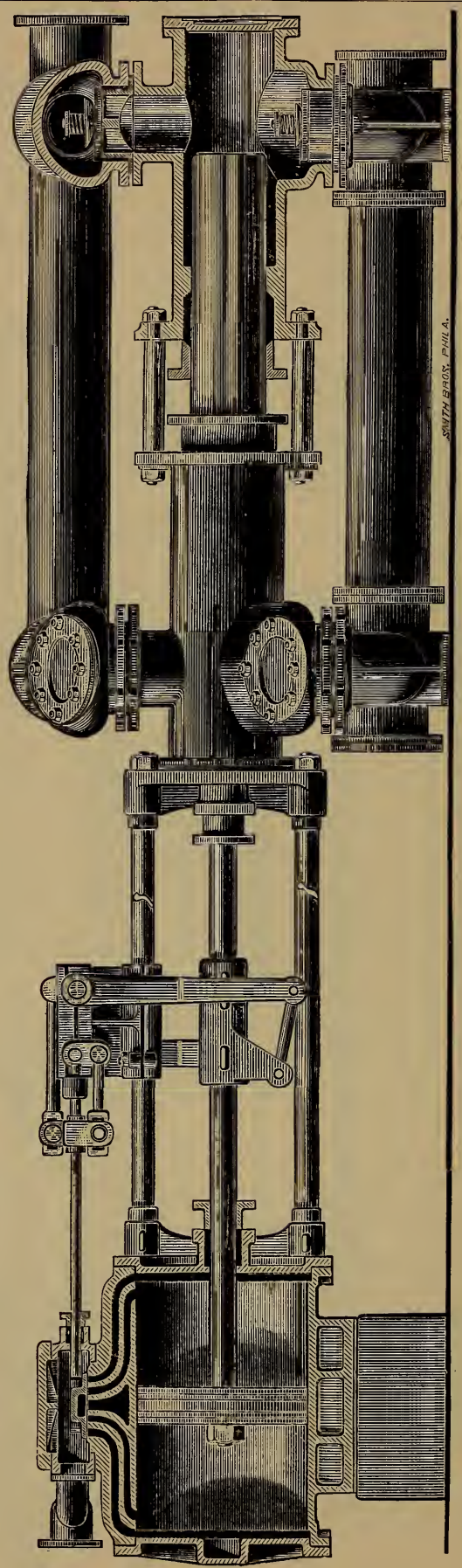
Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
12	7	18	3.00	50 to 90	300 to 540	420	25,200	604,800	2½	3	7	6	
14	7	18	3.00	50 to 90	300 to 540	420	25,200	604,800	3	4	7	6	
16	7	18	3.00	50 to 90	300 to 540	420	25,200	604,800	3	4	7	6	
18	7	18	3.00	50 to 90	300 to 540	420	25,200	604,800	3½	5	7	6	
14	8	18	3.91	50 to 90	391 to 704	547	32,820	787,680	3	4	8	8	
16	8	18	3.91	50 to 90	391 to 704	547	32,820	787,680	3	4	8	8	
18	8	18	3.91	50 to 90	391 to 704	547	32,820	787,680	3½	5	8	8	
20	8	18	3.91	50 to 90	391 to 704	547	32,820	787,680	3½	5	8	8	
22	8	18	3.91	50 to 90	391 to 704	547	32,820	787,680	4	6	8	8	
16	9	18	5.00	50 to 90	500 to 900	700	42,000	1,008,000	3	4	9	8	
18	9	18	5.00	50 to 90	500 to 900	700	42,000	1,008,000	3½	5	9	8	
20	9	18	5.00	50 to 90	500 to 900	700	42,000	1,008,000	3½	5	9	8	
22	9	18	5.00	50 to 90	500 to 900	700	42,000	1,008,000	4	6	9	8	
24	9	18	5.00	50 to 90	500 to 900	700	42,000	1,008,000	4	6	9	8	
26	9	18	5.00	50 to 90	500 to 900	700	42,000	1,008,000	5	7	9	8	
18	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	3½	5	10	8	
20	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	3½	5	10	8	
22	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	4	6	10	8	
24	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	4	6	10	8	
26	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	5	7	10	8	
28	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	5	7	10	8	
30	10	18	6.12	50 to 90	612 to 1102	857	51,420	1,234,080	6	8	10	8	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 12 x 7 x 18 for the first pump in the table, and similarly for any other size.

DUPLEX MINE-PUMPS 24 AND 36 INCHES STROKE.



DUPLEX MINE-PUMPS OF 24 AND 36 INCHES STROKE.

This design of mine-pump is made up of a number of parts which are exact duplicates of each other, the object being to facilitate the replacing of parts corroded by acid water, and without disturbing such parts as are not so corroded.

Any of the pumps tabulated below can be fitted with compound steam-ends, shown on page 56. For list of sizes of condensing apparatus, see page 63.

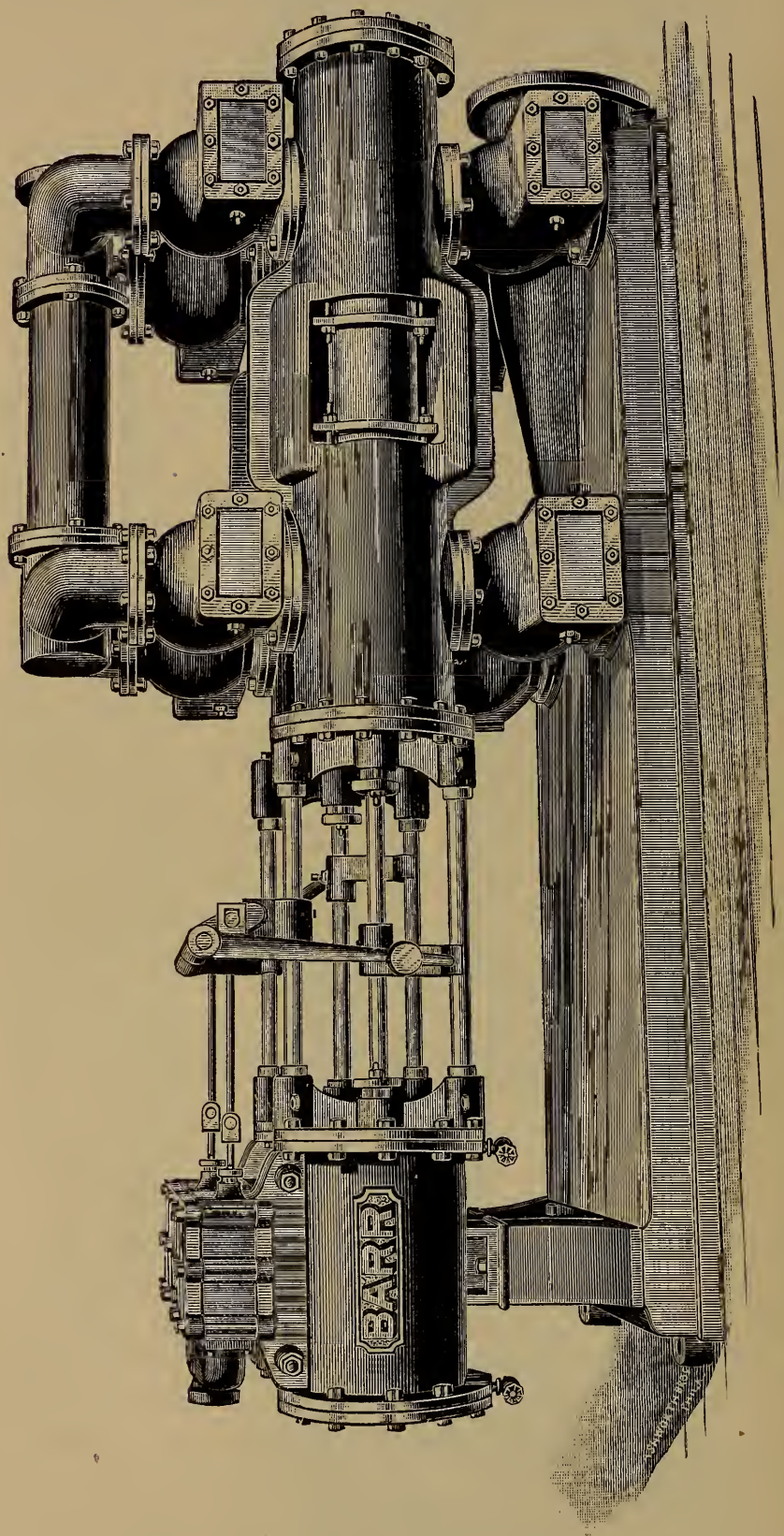
Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.			Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Per 24 Hours.	Steam.	Exhaust.	Suction.	Discharge.	
16	8	24	5.22	40 to 80	417 to 834	626	37,560	901,440	3	4	8	6	
18	8	24	5.22	40 to 80	417 to 834	626	37,560	901,440	3½	5	8	6	
20	8	24	5.22	40 to 80	417 to 834	626	37,560	901,440	3½	5	8	6	
22	8	24	5.22	40 to 80	417 to 834	626	37,560	901.440	4	6	8	6	
24	8	24	5.22	40 to 80	417 to 834	626	37,560	901,440	4	6	8	6	
16	9	24	6.60	40 to 80	528 to 1056	792	47,520	1,140,480	3	4	9	8	
18	9	24	6.60	40 to 80	528 to 1056	792	47,520	1,140,480	3½	5	9	8	
20	9	24	6.60	40 to 80	528 to 1056	792	47,520	1,140,480	3½	5	9	8	
22	9	24	6.60	40 to 80	528 to 1056	792	47,520	1,140,480	4	6	9	8	
24	9	24	6.60	40 to 80	528 to 1056	792	47,520	1,140,480	4	6	9	8	
26	9	24	6.60	40 to 80	528 to 1056	792	47,520	1,140,480	5	7	9	8	
18	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,308,320	3½	5	10	8	
20	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,308,320	3½	5	10	8	
22	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,308,320	4	6	10	8	
24	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,308,320	4	6	10	8	
26	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,308,320	5	7	10	8	
28	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,308,320	5	7	10	8	
30	10	24	8.15	40 to 80	652 to 1304	978	58,680	1,3c8,320	6	8	10	8	
24	9	36	9.92	20 to 50	397 to 992	694	41,640	999,360	4	6	9	8	
26	9	36	9.92	20 to 50	397 to 992	694	41,640	999,360	5	7	9	8	
28	9	36	9.92	20 to 50	397 to 992	694	41,640	999,360	5	7	9	8	
24	10	36	12.25	20 to 50	490 to 1225	857	51,420	1,234,080	4	6	10	8	
26	10	36	12.25	20 to 50	490 to 1225	857	51,420	1,234,080	5	7	10	8	
28	10	36	12.25	20 to 50	490 to 1225	857	51,420	1,234,080	5	7	10	8	
30	10	36	12.25	20 to 50	490 to 1225	857	51,420	1,234,080	6	8	10	8	
24	12	36	17.64	20 to 50	706 to 1764	1235	74,100	1,778,400	4	6	12	10	
26	12	36	17.64	20 to 50	706 to 1764	1235	74,100	1,778,400	5	7	12	10	
28	12	36	17.64	20 to 50	706 to 1764	1235	74,100	1,778,400	5	7	12	10	
30	12	36	17.64	20 to 50	706 to 1764	1235	74,100	1,778,400	6	8	12	10	
32	12	36	17.64	20 to 50	706 to 1764	1235	74,100	1,778,400	6	8	12	10	
36	12	36	17.64	20 to 50	706 to 1764	1235	74,100	1,778,400	8	10	12	10	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 16 x 8 x 24 for the first pump in the table, and similarly for any other size.

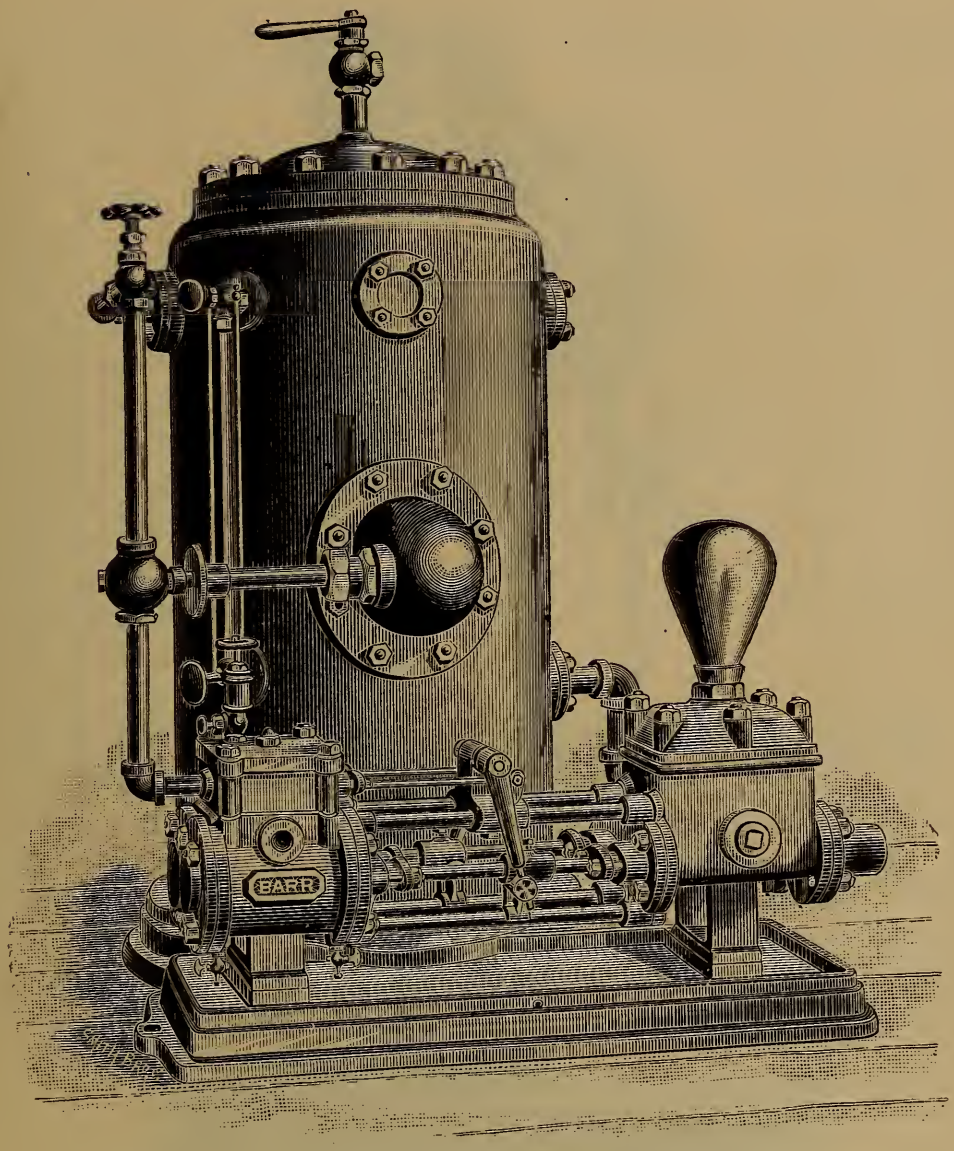
DUPLEX SEWERAGE PUMPING-ENGINE.



Size, 14 x 10 x 18, mounted on bed-plate.

We are prepared to furnish sewerage pumping-engines in any size, and adapted to the special needs of any given locality.

Correspondence solicited.

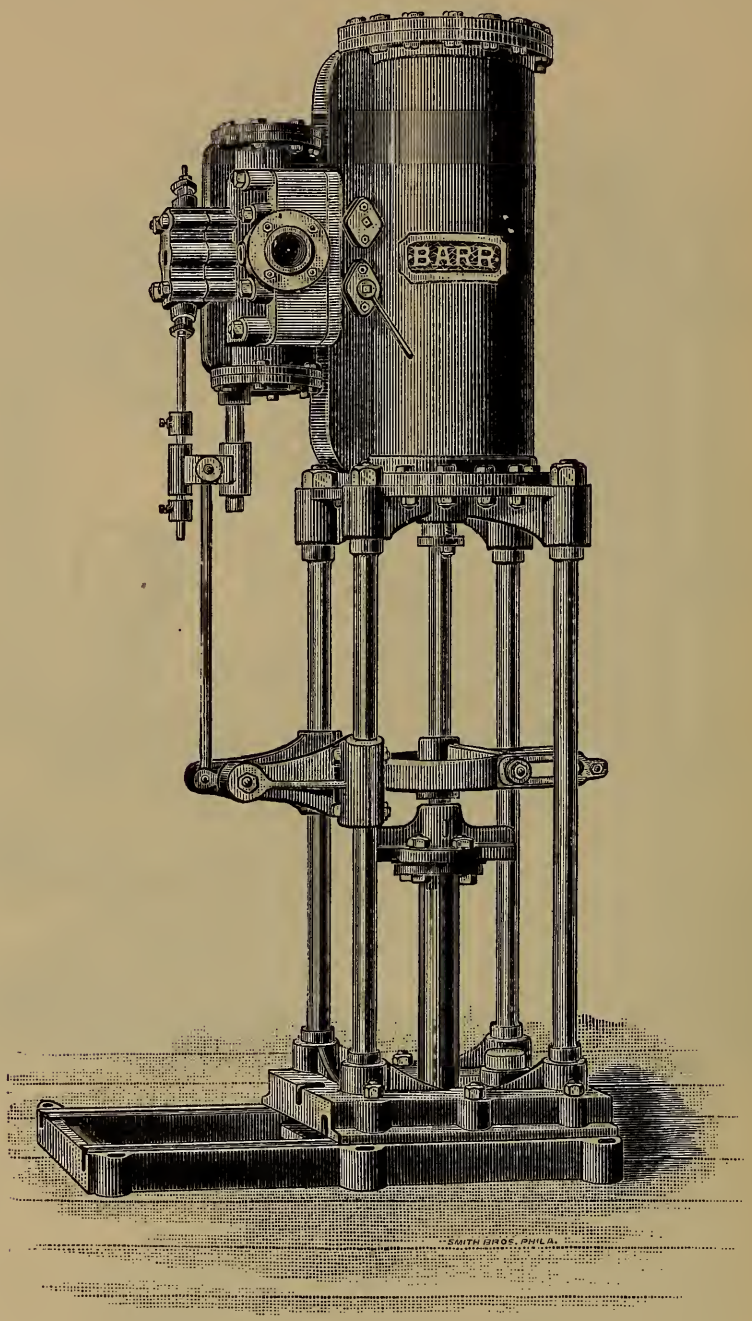


AUTOMATIC FEED-PUMP AND RECEIVER.

For collecting the water of condensation in steam-heating coils and automatically returning it to the boiler. This apparatus is self-contained on a heavy cast-iron bed-plate. The receiver is proven to 100 pounds pressure, the copper float being tested to the same pressure. The pump will be fitted with metal valves for boiling water.

No.	Size of Pump.	Capacity per Minute.	Heating Surface Drained.	PRICE.
1	3 x 2 x 4	10 gallons.	5,000 sq. feet.	
2	4 x 2 x 5	15 "	10,000 " "	
3	4 x 3 x 5	25 "	15,000 " "	
4	5 x 3¼ x 6	40 "	25,000 " "	
5	6 x 4 x 6	80 "	50,000 " "	

Other Sizes and Combinations Made to Order.



Size, 16 x 36.

ARTESIAN-WELL PUMPS.

The steam-end of this pump is mounted on a heavy cast-iron bed-plate securely bolted to a brick foundation at the mouth of the well, the design being such as to permit the steam-cylinder sliding one side of the well, for the easy withdrawal of the plunger-rod and pump-piston.

The steam-cylinder is fitted with double ports at each end, and furnished with adjusting-valves for controlling the action of the steam

both above and below the piston. This method of adjustment is simple and never-failing in its operation, no matter what the depth of the well may be.

The valve-gear is simple and positive in its operation, and under perfect control, the up and down strokes being both uniform and regular at all times.

This pump is built with a differential plunger, the diameter of which is suited to that of the working-barrel with which it is connected. The effect is to deliver one-half of the water on the up stroke and the other half on the down stroke of the plunger, making it a double-acting pump, and without producing any buckling strains on the pump-rod.

A delivery-chamber is furnished each steam-end. This chamber is so designed that it can be entirely removed from the base-plate without disturbing the latter on its foundation, thus permitting the entire withdrawal of the pipe, plunger-rod, and pump from the well when required for examination or repairs.

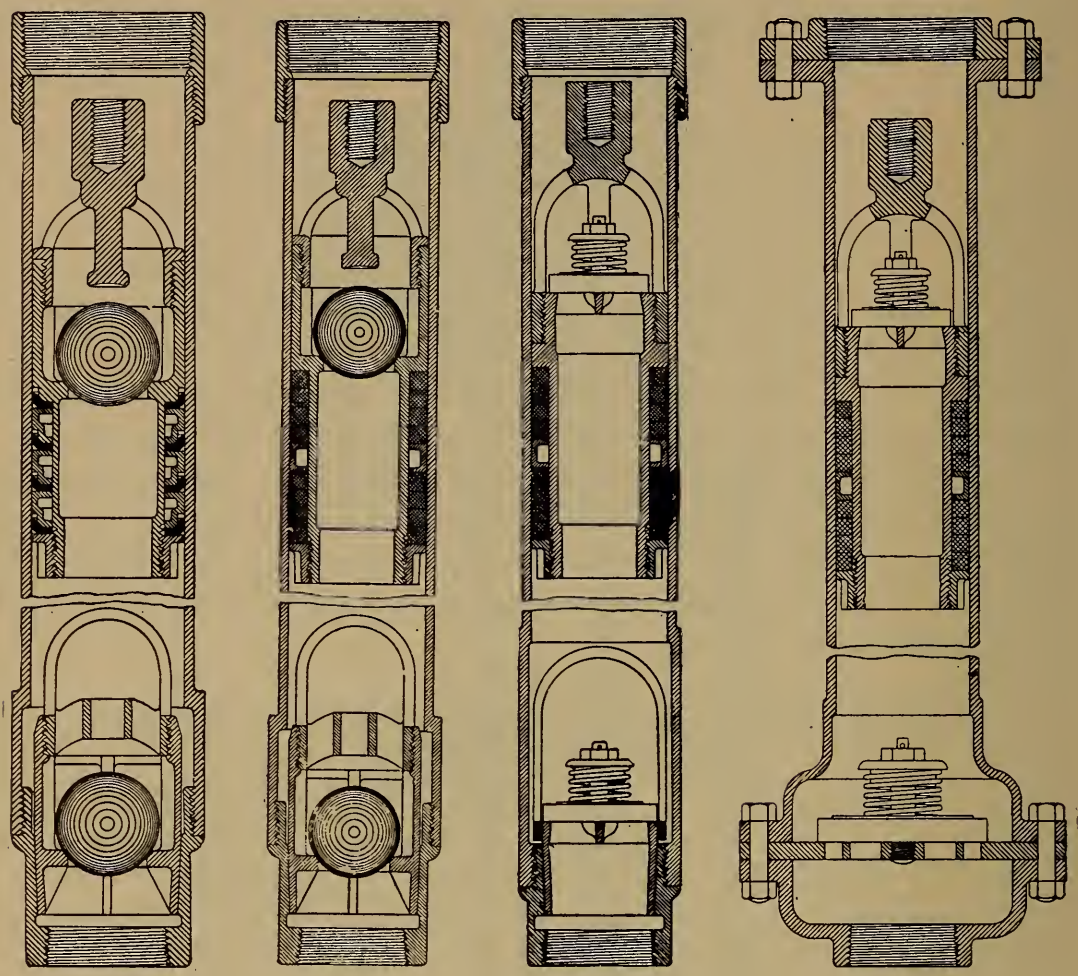
STEAM-ENDS FOR ARTESIAN-WELL PUMPS.

STEAM-CYLINDER.		PIPES.		PRICE.	DIFFERENTIAL PLUNGER.	
Diameter.	Stroke.	Steam.	Exhaust.		Diameter Pump-Piston.	Diameter Diff. Plunger.
6	24	1	1¼		2⅜	1 11/16
7	24	1	1¼		2⅞	2
8	24	1¼	2		3¼	2 5/16
10	24	1¼	2		3¾	2 11/16
12	24	1½	2½		4¼	3 1/16
					4¾	3⅜
8	36	1¼	2		5¼	3 11/16
10	36	1¼	2		5¾	4 1/16
12	36	1½	2½		6¾	4¾
14	36	2	3		7¾	5½
16	36	2	3		8¾	6¼
18	36	2½	3½		9¾	6⅞

All steam-ends will be fitted with differential plungers at the prices quoted above.
24-inch stroke pump speed from 1 to 40 strokes per minute.
36-inch stroke pump speed from 1 to 30 strokes per minute.

AIR-CHAMBERS.

In all cases where the water is to be lifted to a considerable height, it is well to provide the pump with an air-chamber; this should be as near the pump as convenient. A good arrangement is to have a Tee bolted to the pump-delivery flange, and then attach an air-chamber to its upper branch. A check-valve or gate-valve can also be added, if thought desirable.



No. 1. No. 2. No. 3. No. 4.

The water-ends for artesian-well pumps are shown in the accompanying sectional elevations. The working-barrels are all made of hard cast brass, accurately bored and fitted with packed pistons.

Three styles are shown:

No. 1. Water-end is fitted with ball-valves made of hard brass, accurately turned so as to be perfectly spherical. The foot-valve cage fits into a bored conical socket at the bottom of the working-barrel. This cage is made with a bale, so that it can be removed by a hook from the top. Each piston is also fitted with a ball-valve. Cup leather packings held in place by brass rings accurately fitting both the piston and the working-barrel, held in place by a screw-collar as shown in the engraving, complete a design which more nearly meets all the requirements of artesian-well service than, perhaps, any other design. The bottom of the working-barrel casting is fitted with a pipe-thread, so that a piece of wrought-iron pipe can be added to

the length of the pump for lifting water from a greater depth and shortening the main-pipe and pump-rod if thought desirable.

No. 2. Water-end is fitted with ball-valves and cages, the same as No. 1; the principal difference being in the substitution of a piston adapted for the use of Tuck's packing instead of cup leathers.

No. 3. Water-end is fitted with flat valves, of either rubber or metal, as shall appear best suited to the work. This piston is adapted for the use of Tuck's packing. It is guided centrally by a brass ring, and further guided by a brass screw-collar holding all in place from the bottom.

No. 4. Water-end is not an artesian working-barrel, but is a design for open wells. With the exception of the lower valve, everything about this pump is the same as for corresponding sizes of artesian-well pumps.

WATER-ENDS FOR ARTESIAN-WELL PUMPS.

Prices for Water-Ends, Nos. 1, 2, and 3.

PUMP.		PRICE.	Inside Diameter Wrought-Iron Pipe.	Pump Rod Wrought-Iron Pipe.	Gallons per Stroke.	Diameter of Well-Casing.		Diameter Delivery Pipe.	PRICE OF CONNECTIONS.		
Diameter.	Stroke.					Inside.	Outside.		Pump Pipe Per Foot.	Pump Rod Per Foot.	Brass Coupling. Each.
2⅜	24		2½	¾	.46	4	4¼	1½	$0.44	$0.04	$1.10
2⅞	24		3	1	.67	4½	4¾	1½	.58	.09	1.90
3¼	24		3½	1	.86	5	5¼	2	.70	.09	1.90
3¾	24		4	1¼	1.14	6¼	6⅝	2	.85	.12	2.80
4¼	24		4½	1¼	1.48	6¼	6⅝	2	1.00	.12	2.80
4¾	24		5	1½	1.84	6⅝	7	2½	1.20	.22	3.25
5¼	24		6	1½	2.25	7⅝	8	2½	1.20	.22	3.25
5¾	24		6	2	2.70	8¼	8⅝	3	1.65	.28	4.50
2¾	36		3	1	.93	4½	4¾	1½	.58	.09	1.90
3¼	36		3½	1	1.29	5	5¼	2	.70	.09	1.90
3¾	36		4	1¼	1.72	6¼	6⅝	2	.85	.12	2.80
4¼	36		4½	1¼	2.22	6¼	6⅝	2	1.00	.12	2.80
4¾	36		5	1½	2.76	6⅝	7	2½	1.20	.22	3.25
5¼	36		6	1½	3.38	7⅝	8	2½	1.20	.22	3.25
5¾	36		6	2	4.05	8¼	8⅝	3	1.65	.28	4.50
6¾	36		7	2	5.58	9	9⅝	3½	2.00	.28	4.50
7¾	36		8	2	7.35	10	10¾	3½	2.75	.28	4.50
8¾	36		9	2	9.38	11	11¾	4	3.70	.28	4.50
9¾	36		10	2½	11.64	12	12¾	4	4.75	.44	5.75

No. 4. Water-ends will be provided with suitable flanges for securing either to side timbers in the well, or with a flanged base for bolting to a timber platform.

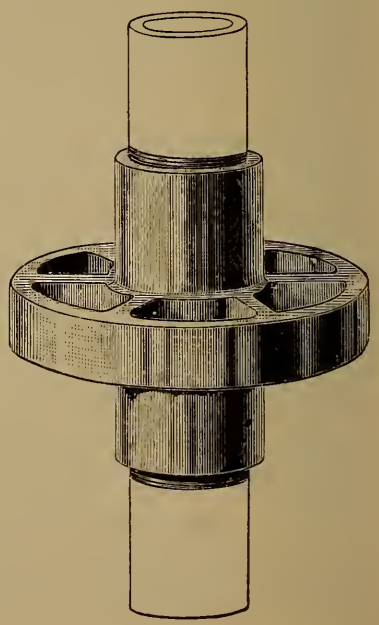
ASH PUMP-RODS

With wrought-iron screw and socket make the most satisfactory connection between the differential plunger at the top and the water-piston at the bottom of the well. We make four sizes of rods for the several water-ends, as below.

1½	inch	Ash	Rods	for	pumps	to	3¼	x 36	inches.
1¾	"	"	"	"	"		4¾	x 36	"
2	"	"	"	"	"		6¾	x 36	"
2⅜	"	"	"	"	"		9¾	x 36	"

BRASS COUPLINGS.

When pump-rods are constructed of wrought-iron pipe, they are usually fitted with brass couplings similar in design to the annexed engraving.



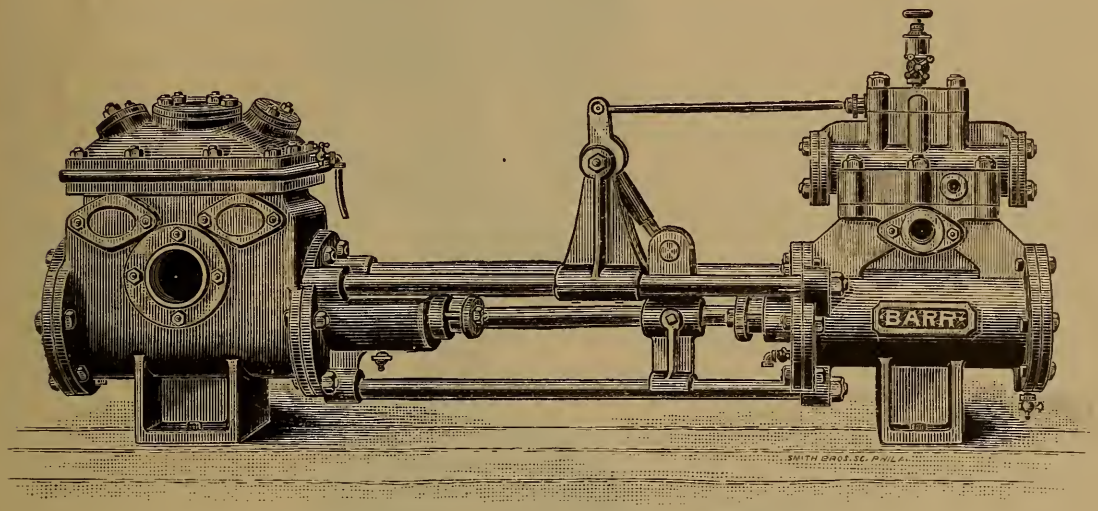
The coupling is tapped at each end to receive the wrought-iron pipe, and is further provided with an annular guide to steady the pump-rod within the wrought-iron well-pipe, and thus relieve the pump-rod of any strains upon the joints incident to the buckling of the rod when running rapidly on the down stroke.

One such coupling should be provided for each length of pipe, say every 16 feet.

Prices of these couplings are given in the table of water-ends.

DIRECT-ACTING VACUUM-PUMPS,

SINGLE PATTERN.



This is a type of pump largely used in connection with steam-heating coils in manufactories, public buildings, etc. They are well suited for sugar-works on plantations, for chemical works, glue factories, condensed milk factories, and all industries and processes requiring a vacuum.

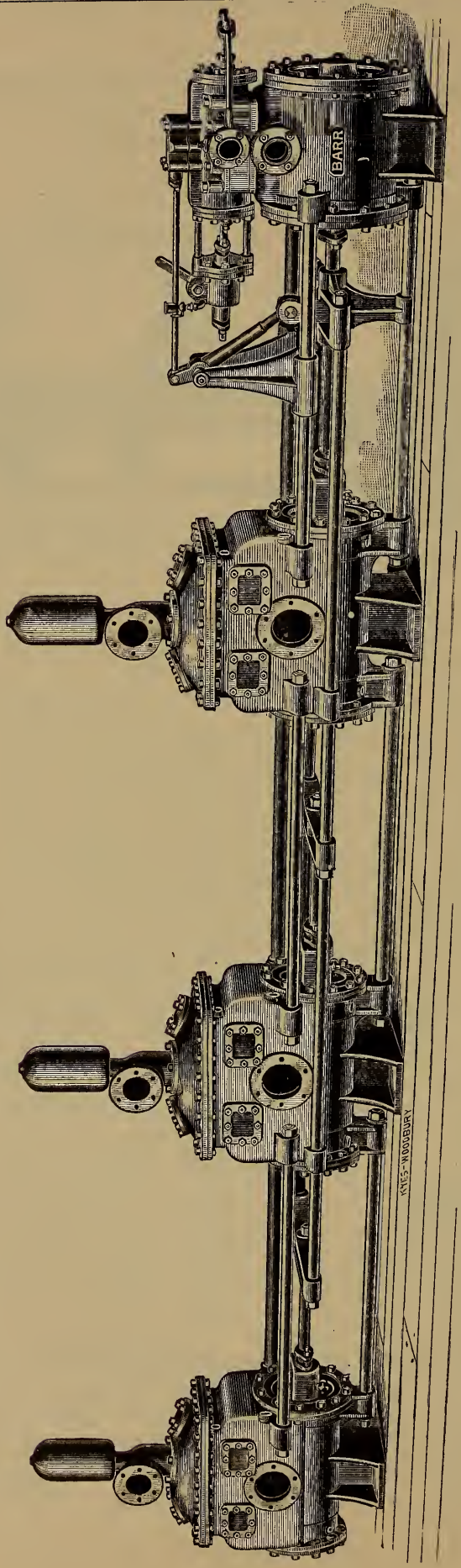
These pumps are very compact, thoroughly well made, the water-cylinders are fitted with a removable brass lining, brass piston-rod and piston, valves fitted with a water-seal, the piston-rod passes through double stuffing-boxes with water-seal between, so that air cannot leak back into the main cylinder of the pump.

DIAMETER.		Length of Stroke. Inches.	DISPLACEMENT.		Diameter of Pipes in Inches.				REMARKS.
Steam-Cylinders. Inches.	Pump-Cylinders. Inches.		Cubic Inches per Stroke.	Cubic Feet at 100 Feet Piston Speed.	Steam.	Exhaust.	Suction.	Discharge.	
4	5	8	157	27.2	½	¾	3	3	
6	6	8	226	39.8	¾	1	4	4	
6	7	12	462	53.4	1	1¼	5	5	
6	8	12	600	69.3	1	1½	5	5	
8	10	12	942	109.0	1¼	2	6	6	
10	12	12	1356	157.0	1¼	2	7	7	
10	14	18	2772	213.3	1¼	2	8	8	
12	16	18	3618	278.4	1½	2½	8	8	

Larger sizes and other combinations to order.

These pumps can be supplied with pan bed-plates fitted with tapped pipe-openings for conveying any drippings to an underground drain. Bed-plates can be furnished with an ornamental grating fitting into the top of the pan, if so desired. We recommend that all vacuum-pumps be supplied with them. Prices quoted on application.

TRIPLE-EFFECT PUMP.



Size, 20 x 14 x 18.

STEAM PUMPS FOR DOUBLE AND TRIPLE EFFECT.

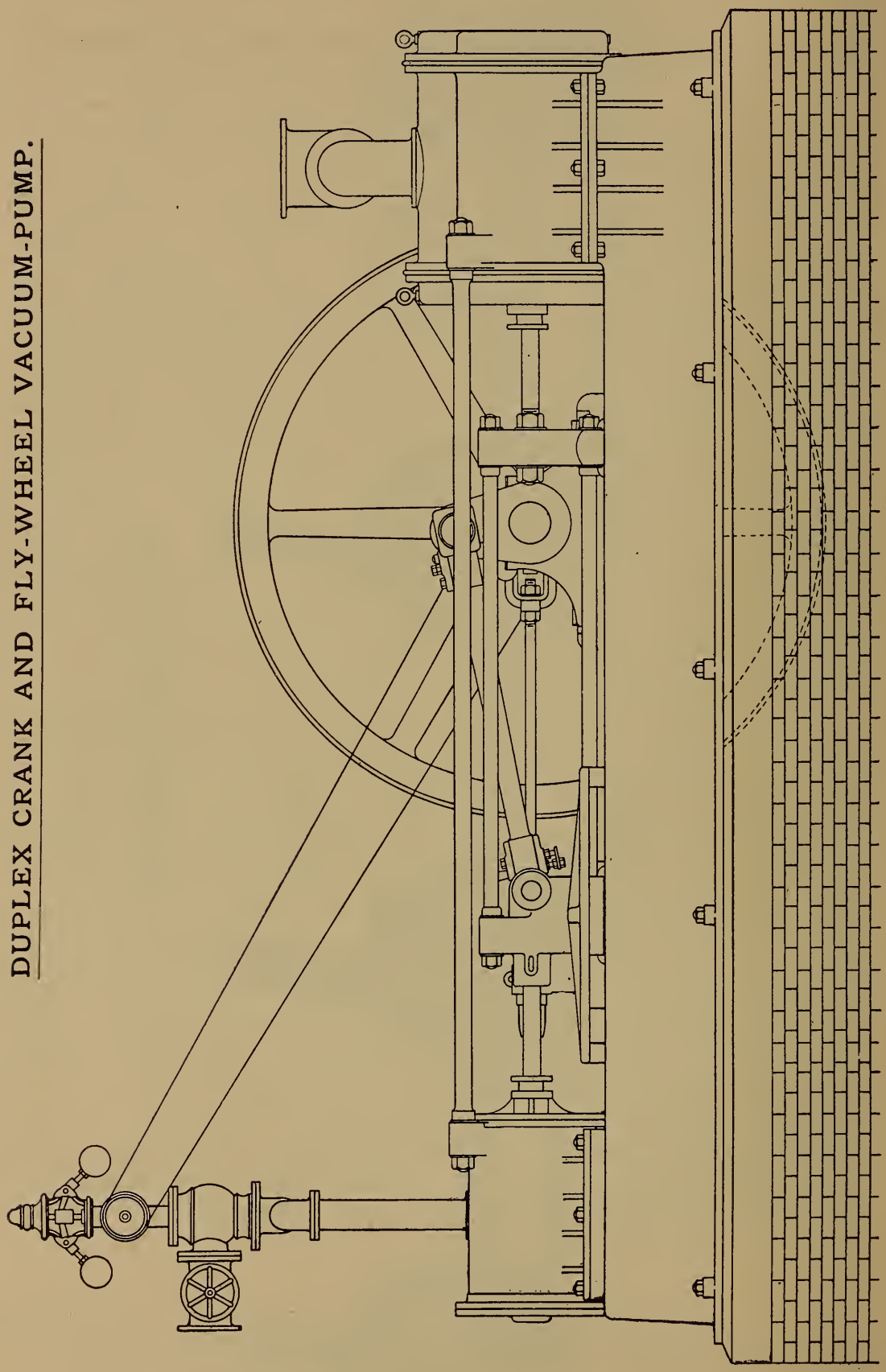
The illustration on the opposite page represents a pump designed for triple-effect apparatus. The steam-end is fitted with hand starting-gear and cataract for controlling the movement of the piston operating the main valve. The valve-gear is simple in construction and positive in its action. The piston-rod in the steam-cylinder attaches to a cross-head, and is made of steel; on the other side of this cross-head a brass piston-rod extends into the first pump. The inside head is fitted with a water-seal, so that no air can pass through the stuffing-box into the valve-chambers of the pump. The cross-head is so constructed that parallel rods extend on either side of the first water-end so as to operate the second pump without carrying the piston-rod through the back head of the first pump; this second cross-head is fitted so that an extension of the parallel rods is carried on either side of the second cylinder and attaches to a cross-head for operating the third pump. These parallel rods are guided on the first and second cylinders. By this arrangement any one of the three water-ends may be disconnected, and in the event that the pistons should require examination or repair they can be taken out without disturbing the pump on its foundations.

These pumps are of the piston pattern, with removable composition linings so arranged that they may be partially turned so as to bring fresh surfaces in contact with the bottom of the piston, should there be unusual wear or cutting in that portion of the lining. The valves can be made of hard vulcanite or brass, as may be preferred; they are fitted with a water-seal, so as to insure tightness. Hand-hole plates are provided on the suction and delivery side of the pump, so that any valve may be examined, removed, and replaced without drawing the charge from the cylinders of the pumps. These water-ends will be provided with suction-openings on both sides of the pump and provided with a blank flange, so that either side may be shut off. The delivery-elbows will be drilled so that the flange will face quartering, or can be drilled to lead in any direction that may be desired.

Although the illustration shows a triple-effect pump, we make them double-effect, and are prepared to submit designs, specifications, and prices for any number of effects in any size of apparatus.

Crank and Fly-Wheel Combination Pumps in any size, suited to the above service, made to order. Designs and prices on application.

DUPLEX CRANK AND FLY-WHEEL VACUUM-PUMP.



DUPLEX CRANK AND FLY-WHEEL VACUUM-PUMP.

Duplex Vacuum-Pumps, of the design shown on the opposite page, are probably the most satisfactory in their operation of any type of pump yet introduced for vacuum purposes in sugar-making, and other processes which require the highest attainable efficiency.

The cranks are set at right angles to each other, so that the "pull on the vacuum" is practically continuous throughout a complete revolution of the crank-shaft. No dead points occur in the revolution, so that the pump will start at any position of the steam-pistons.

As this type of pump has a measured stroke, a certain displacement is had for each revolution of the crank-shaft; its efficiency is, therefore, as near perfect as is possible in any type of machine. This design of vacuum-pump is more economical in the use of steam than any direct-acting pump, by reason of the stored-up energy in the rim of the wheel; it also permits the employment of a cut-off or expansion-valve in the steam-cylinder, should such an economy of steam be thought desirable.

The vacuum-cylinder is fitted with a cast-brass lining; the valve-plates are also made of cast brass, and are so arranged that they may be entirely removed from the pump without disturbing any of the main castings.

Diameter of Steam-Cylinder.	Diameter of Air-Pump.	Length of Stroke.	Cubic Feet Displacement per Revolution.	Cubic Feet Displacement at 50 Revolutions per Minute.	SIZE OF PIPES.				PRICE.
					Steam.	Exhaust.	Vacuum.*	Discharge.*	
6	8	12	1.39	69.50	1½	2	4	3	
7	10	12	2.18	109.00	1½	2	5	4	
8	12	18	4.71	235.50	1½	2	6	4	
9	14	18	6.42	320.80	2	2½	7	5	
10	16	24	11.17	558.50	2	2½	8	6	
12	18	24	14.14	706.84	2½	3	9	7	
14	20	24	17.45	872.80	3	4	10	7	
16	22	24	21.12	1,056.00	3	4	11	8	
16	24	24	25.12	1,256.00	3	4	12	8	

*The diameters of both vacuum and discharge pipes may be changed to suit the requirement of a customer.
The vacuum-cylinders will be adapted for either wet or dry process.
Designs and estimates for other sizes and for any service will be furnished on application.

AIR-COMPRESSORS.

We are prepared to furnish air-compressors adapted to both high and low pressures, embodying all the latest improvements, and adapted to both the wet and dry systems. The inlet- and delivery-valves are easy of access, the compression-cylinders are provided with water-jackets for absorbing the heat of compression. Compressors will be furnished with either horizontal or vertical engines, as shall best meet the requirements of the purchaser.

These compressors can be fitted with receiving-tanks for the smaller sizes, making a compact, self-contained machine for moving thick liquids, acids, or for other purposes.

Especial attention will be given to compressors subject to difficult transportation in mountainous districts, in which case parts will be made as small and as light as possible consistent with the service required of them.

Designs and estimates furnished on application.

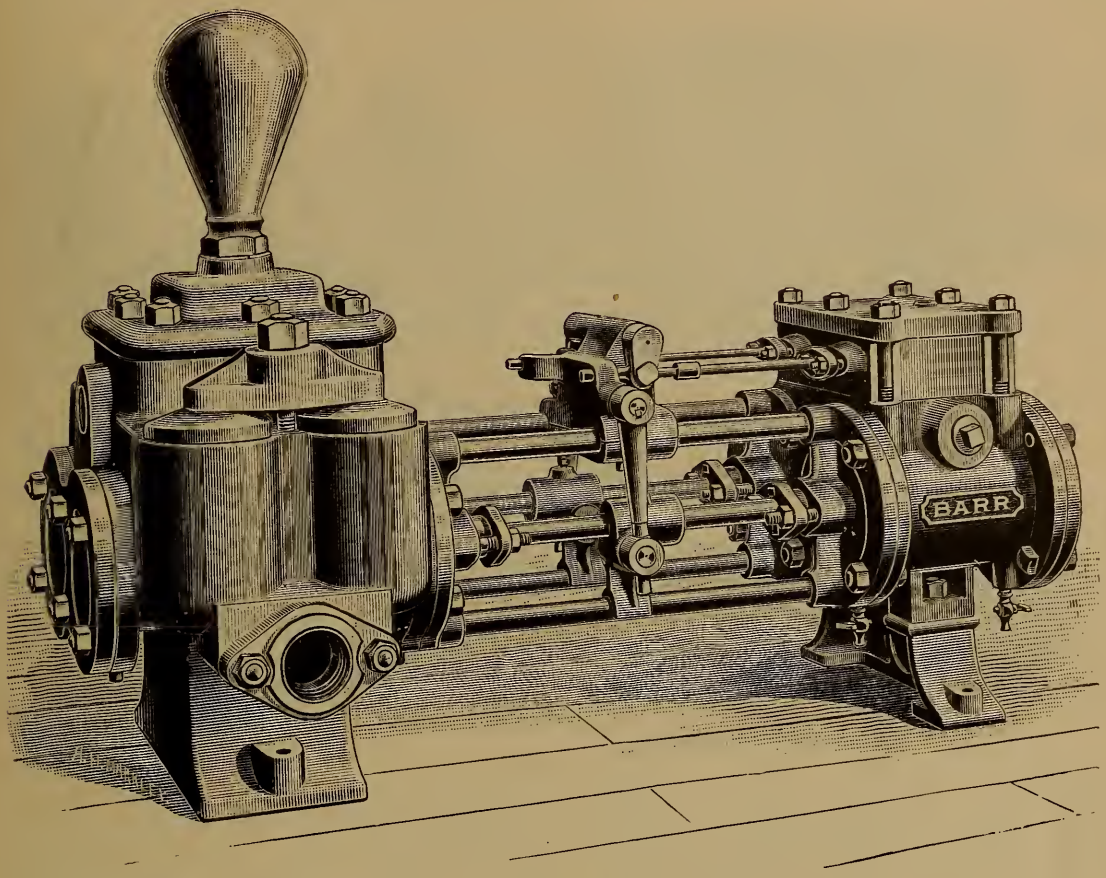
GAS-COMPRESSORS.

Gas-compressors specially designed for compressing ammonia gas for ice-making, cold storage, or other refrigerating service.

These pumps are designed for pressures up to 250 pounds per square inch. The valves are readily accessible. Especial attention is paid to the stuffing-boxes, which are of unusual length and of special construction, with grating and reservoir for sealing-oil, with force-pump attached. The whole of the pump is submerged in a tank, through which a current of water passes in order to maintain an even temperature of the working-barrel.

These pumps are double-acting, and constructed with great care, and guaranteed to be equal in efficiency to the best compressors yet introduced. They will be fitted with either vertical or horizontal engines, and in any size suited to the requirements of ice-making, cold storage, etc.

Designs and prices furnished on application.



DUPLEX SUGAR-HOUSE PUMP WITH BALL-VALVES.

This type of pump is specially adapted for handling hot or cold syrups, juices, or skimmings containing trash, chips, or shreds of cane.

It is well suited to filter press-work.

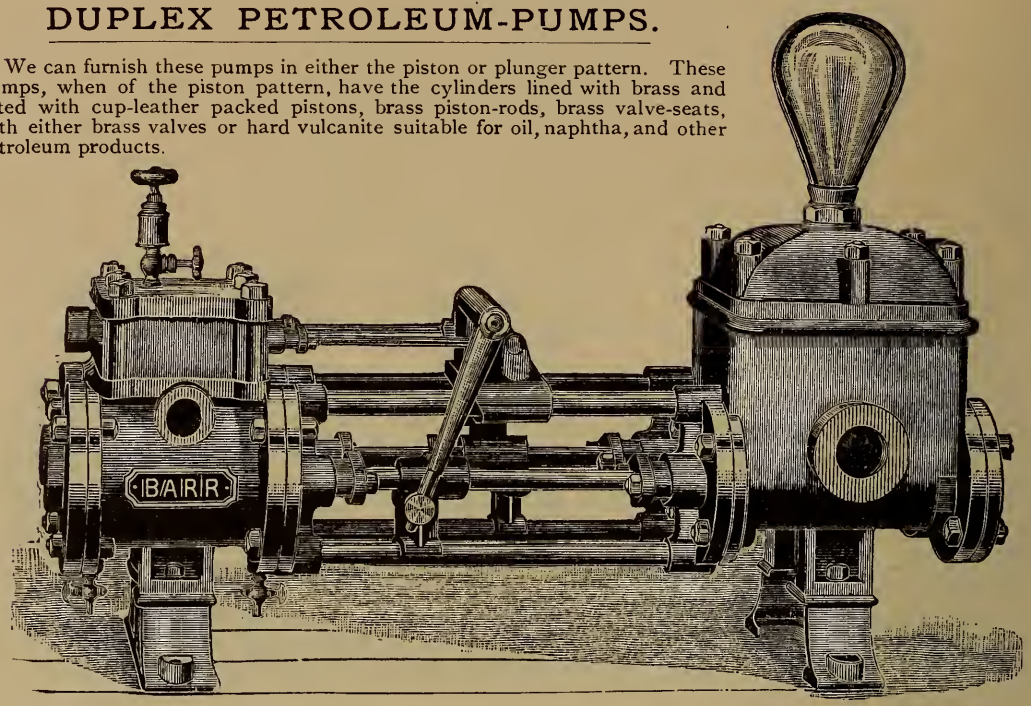
Diameter of Steam-Cylinders.	Diameter of Water-Cylinders.	Length of Stroke.	Gallons per Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
4	2½	5	.10	75 to 125	15 to 30	22	1,320	¾	1	1½	1¼	
5	3¼	6	.21	75 to 125	31 to 52	42	2,520	1	1¼	2	1½	
6	4	6	.33	75 to 125	49 to 82	66	3,960	1	1½	3	2	
7	4	8	.43	75 to 125	64 to 107	86	5,160	1½	2	3	2	
7	5	8	.68	75 to 125	102 to 170	136	8,160	1½	2	4	3	

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one piston by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be brass-fitted at a slight advance over the regular prices given above.

DUPLEX PETROLEUM-PUMPS.

We can furnish these pumps in either the piston or plunger pattern. These pumps, when of the piston pattern, have the cylinders lined with brass and fitted with cup-leather packed pistons, brass piston-rods, brass valve-seats, with either brass valves or hard vulcanite suitable for oil, naphtha, and other petroleum products.



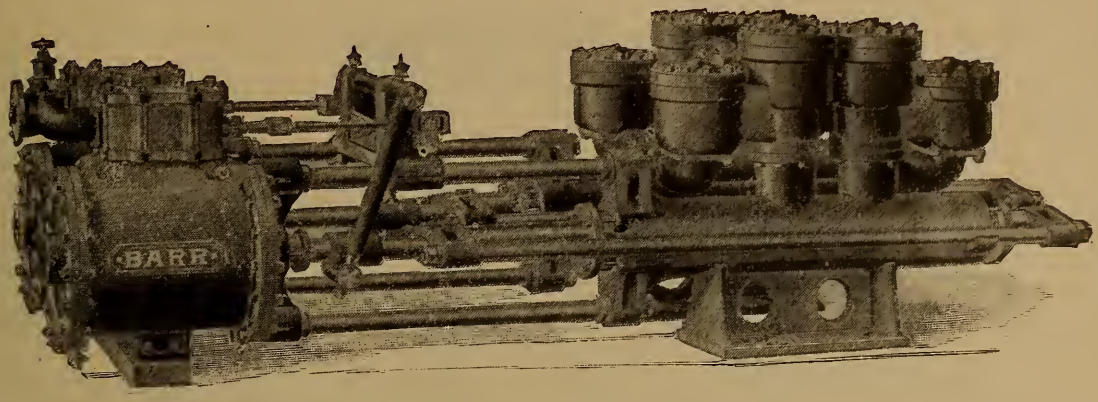
Diameter of Steam-Cylinders.	Diameter of Water-Pistons.	Length of Stroke.	Displacement in Gallons for One Stroke of One Piston.	Ordinary Strokes per Minute of One Piston.	Gallons Delivered by Both Pistons at Stated Number of Strokes per Minute.	Gallons Delivered by Both Pistons at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
3	2	4	.05	100 to 200	10 to 20	15	900	½	¾	1	¾	
4	2½	5	.10	100 to 200	20 to 40	30	1,800	¾	1	1½	1¼	
4	3	5	.15	100 to 200	30 to 60	45	2,700	¾	1	2	1½	
5	3¼	6	.21	100 to 175	42 to 74	58	3,480	1	1¼	2	1½	
5	4	6	.33	100 to 175	66 to 116	91	5,460	1	1¼	3	2	
6	3	8	.24	100 to 150	48 to 72	60	3,600	1	1½	2	1½	
6	4	8	.43	100 to 150	86 to 130	108	6,480	1	1½	3	2	
6	5	8	.68	100 to 150	136 to 204	170	10,200	1	1½	4	2½	
8	4	10	.54	75 to 125	81 to 135	108	6,480	1½	2	3	2	
8	5	10	.85	75 to 125	127 to 212	170	10,200	1½	2	4	3	
8	6	10	1.22	75 to 125	183 to 305	244	14,640	1½	2	4	3	
10	7	12	2.00	75 to 125	300 to 500	400	24,000	2	2½	6	5	
12	7	12	2.00	75 to 125	300 to 500	400	24,000	2½	3	6	5	
10	8	12	2.61	75 to 125	391 to 652	522	31,320	2	2½	6	5	
12	8	12	2.61	75 to 125	391 to 652	522	31,320	2½	3	6	5	
12	10	12	4.08	75 to 125	612 to 1020	816	48,960	2½	3	8	7	
14	10	12	4.08	75 to 125	612 to 1020	816	48,960	3	4	8	7	

Other sizes and combinations made to order.

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-pistons, and the length of stroke; thus, 3 x 2 x 4 for the first pump in the table, and similarly for any other size.



DUPLEX OIL-LINE PUMPS.

These pumps are specially fitted for heavy pressures. The movement of each steam-valve is controlled by the piston of the opposite cylinder, transmitted across the framing of the pump to each valve-rod respectively. This movement is always certain in its action. Its entire freedom from supplemental valves, ports, and other complications makes it the most desirable valve-gear known; and, as the valve of one cylinder is actuated and controlled by the piston of the opposite cylinder, no dead points can occur in the stroke; consequently, the pump can be started at any time with absolute certainty. The pump-ends have outside connected double-acting plungers, with external adjustable stuffing-box glands. The valves and seats are carefully designed for the work required of them. The delivery is at all times constant and uniform.

These pumps can be made suitable for any pressure from 300 to 1000 pounds.

Diameter of Steam-Cylinders.	Diameter of Water-Plungers.	Length of Stroke.	Displacement in Gallons for One Stroke of One Plunger.	Ordinary Strokes per Minute of One Plunger.	Gallons Delivered by Both Plungers at Stated Number of Strokes per Minute.	Gallons Delivered by Both Plungers at a Mean of the Ordinary Strokes per Minute.		Diameter of Pipes in Inches.				PRICE.
						Per Minute.	Per Hour.	Steam.	Exhaust.	Suction.	Discharge.	
10	3	12	.37	25 to 70	18 to 52	35	2,100	2	2½	2½	1½	
12	3	12	.37	25 to 70	18 to 52	35	2,100	2½	3	2½	1½	
12	4	12	.65	25 to 70	32 to 91	62	3,720	2½	3	3	2	
14	4	12	.65	25 to 70	32 to 91	62	3,720	3	4	3	2	
14	5	12	1.02	25 to 70	51 to 143	97	5,820	3	4	4	2½	
16	5	12	1.02	25 to 70	51 to 143	97	5,820	3	4	4	2½	
16	6	18	2.20	20 to 65	88 to 286	187	11,220	3	4	5	3	
18	6	18	2.20	20 to 65	88 to 286	187	11,220	3½	5	5	3	
20	7	18	3.00	20 to 65	120 to 390	255	15,300	3½	5	6	4	
24	7	18	3.00	20 to 65	120 to 390	255	15,300	4	6	6	4	
24	8	24	5.22	20 to 60	209 to 626	418	25,080	4	6	6	4	
26	8	24	5.22	20 to 60	209 to 626	418	25,080	5	7	6	4	
30	8	24	5.22	20 to 60	209 to 626	418	25,080	6	8	6	4	

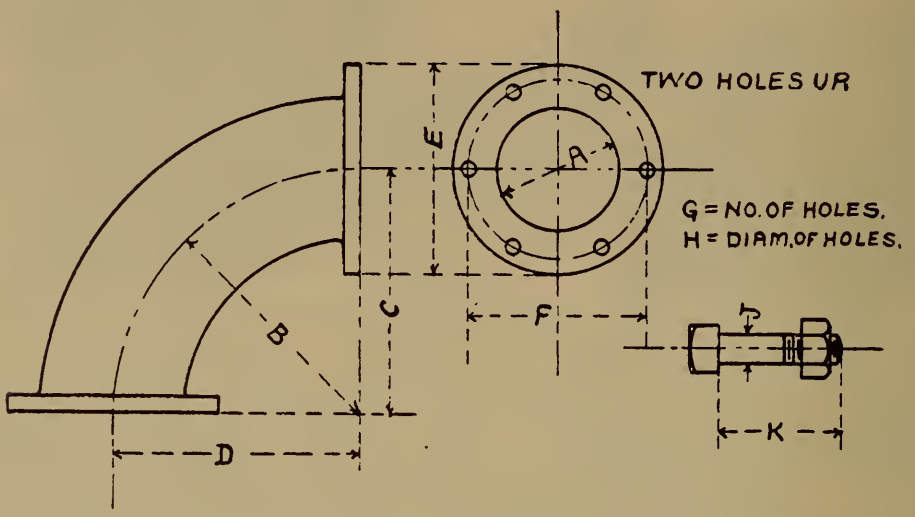
Other sizes and combinations made to order. All sizes can be fitted with compound steam-ends.

Note.—In a duplex pump the number of gallons delivered per minute is found by multiplying the displacement of one plunger by twice the number of strokes.

An extra charge will be made for bed-plates. Pumps can be fitted with brass plungers at a slight advance over the regular prices.

Sizes are designated by giving the diameter of steam-cylinders, the diameter of water-plungers, and the length of stroke; thus, 10 x 3 x 12 for the first pump in the table, and similarly for any other size.

FLANGED ELBOWS.

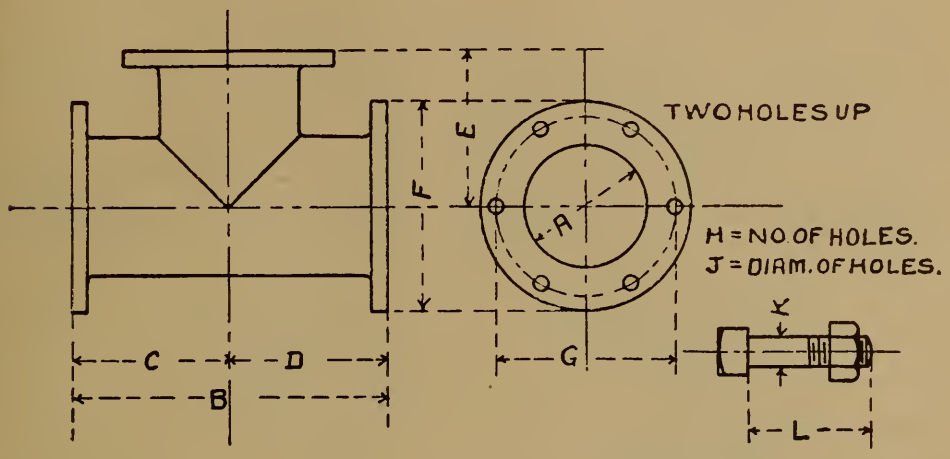


We have adopted as a standard radius two diameters of the pipe. Our patterns are so made that they may be lengthened, and for that reason dimensions **C** and **D** are given. The figures in the table represent the shortest distances. In ordering flanged elbows the distance **C** and the distance **D** may be increased, or both; any change in either one of these two dimensions constitutes an extra. It is our practice in drilling to always have two holes up, as shown in the engraving. If, however, the elbow is to be placed on its side, then the two holes up will be at right angles to the position shown.

These elbows are extra heavy, and intended for water-works service.

Diameter.	Radius.	Centre to Face.		Diameter of Flange.	Diameter of Bolt Circle.	Number of Bolt Holes	Diameter of Bolt Holes	BOLTS.		PRICE.
								Diameter.	Length.	
A	B	C	D	E	F	G	H	J	K	
4	8	8	8	9	7¼	5	11/16	5/8	2⅜	
5	10	10	10	10	8¼	5	11/16	5/8	2⅜	
6	12	12	12	11	9¼	6	11/16	5/8	2⅝	
7	14	14	14	12	10¼	6	13/16	¾	2¾	
8	16	16	16	13	11¼	8	13/16	¾	2¾	
10	20	20	20	16	13⅞	8	13/16	¾	2¾	
12	24	24	24	18	15⅞	10	13/16	¾	3	
14	28	28	28	20	18⅛	12	13/16	¾	3	
16	32	32	32	22	20⅛	14	13/16	¾	3¼	
18	36	36	36	24	22⅛	16	15/16	⅞	3¼	
20	40	40	40	26	24⅛	18	15/16	⅞	3¾	
22	44	44	44	28	26⅛	18	15/16	⅞	4	
24	48	48	48	30	28⅛	20	15/16	⅞	4	

FLANGED TEES.

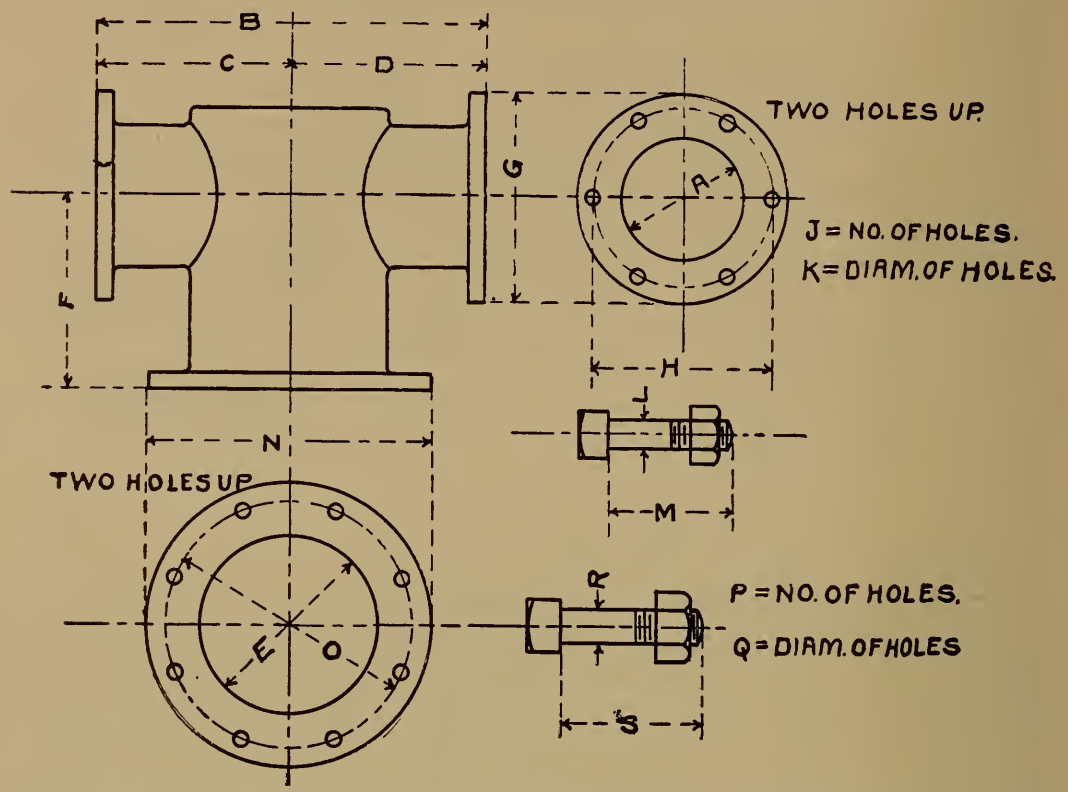


The dimensions given in the table are for our standard work, and represent shortest distances. The distances **C** and **D** can be lengthened to any extent either side of the centre line, so also can the distance **E**, the changes being charged as an extra. In drilling we always place the holes up, as shown in the engraving. If a tee is to be placed horizontally the two holes will still be up, and the drilling would be at right angles to the position shown in the engraving.

These castings are extra heavy, and intended for water-works service.

Diameter.	Face to Face.	Face to Centre.			Diameter of Flange.	Diameter of Bolt Circle.	Number of Bolt Holes.	Diameter of Bolt Holes.	BOLTS.		PRICE.
									Diameter.	Length.	
A	B	C	D	E	F	G	H	J	K	L	
4	14	7	7	7	9	7¼	5	11/16	5/8	2⅜	
5	16	8	8	8	10	8¼	5	11/16	5/8	2⅜	
6	16	8	8	8	11	9¼	6	11/16	5/8	2⅝	
7	18	9	9	9	12	10¼	6	13/16	¾	2¾	
8	18	9	9	9	13	11¼	8	13/16	¾	2¾	
10	22	11	11	11	16	13⅜	8	13/16	¾	2¾	
12	24	12	12	12	18	15⅜	10	13/16	¾	3	
14	26	13	13	13	20	18⅛	12	13/16	¾	3	
16	30	15	15	15	22	20⅛	14	13/16	¾	3¼	
18	32	16	16	16	24	22⅛	16	15/16	⅞	3¼	
20	36	18	18	18	26	24⅛	18	15/16	⅞	3¾	
22	38	19	19	19	28	26⅛	18	15/16	⅞	4	
24	40	20	20	20	30	28⅛	20	15/16	⅞	4	

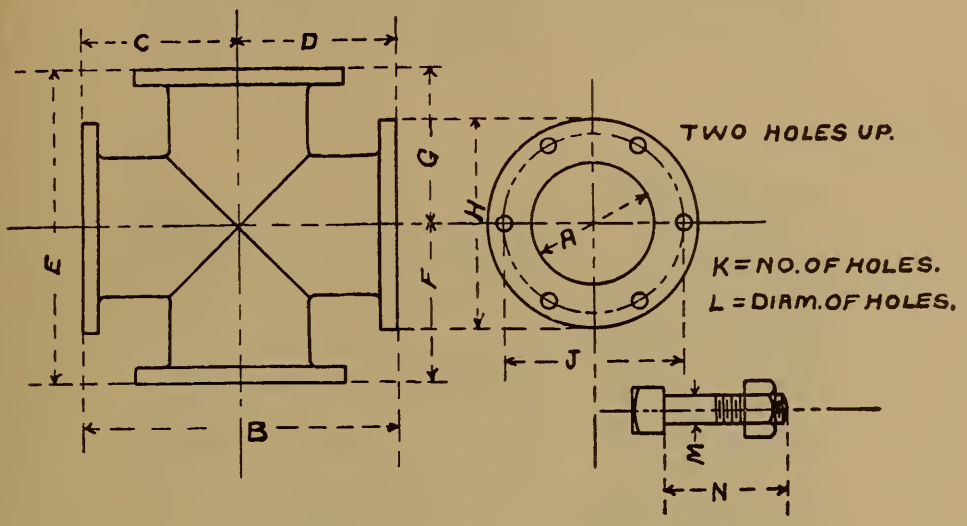
SUCTION OR DELIVERY TEES.



This is a special tee arranged to go between two pumping-engines where there is not sufficient space to use elbows. The diameter **A** is that leading to the pump, the diameter **E** is that which connects to the main. The distance **B** is the shortest that we can make with our patterns, but may be increased in distance **C** or **D**, or both, to suit the needs of a customer. The distance **F** may also be lengthened.

Diameter.	Face to Face.	Face to Centre.		Diameter.	Face to Centre.	Diameter of Small Flange.	Diameter of Bolt Circle.	Number of Bolt Holes.	Diameter of Bolt Holes.	Diameter of Bolt.	Length of Bolt.	Diameter of Large Flange.	Diameter of Bolt Circle.	Number of Bolt Holes.	Diameter of Bolt Holes.	BOLTS.		PRICE.
A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	Diameter. R	Length. S	
4	16	8	8	6	8	9	7¼	5	11/16	5/8	2⅜	11	9¼	6	11/16	5/8	2⅝	
5	18	9	9	7	9	10	8¼	5	11/16	5/8	2⅜	12	10¼	6	13/16	¾	2¾	
6	18	9	9	8	9	11	9¼	6	11/16	5/8	2⅝	13	11¼	8	13/16	¾	2¾	
7	22	11	11	10	11	12	10¼	6	13/16	¾	2¾	16	13⅞	8	13/16	¾	2¾	
8	24	12	12	12	12	13	11¼	8	13/16	¾	2¾	18	15⅞	10	13/16	¾	3	
10	26	13	13	14	13	16	13⅞	8	13/16	¾	2¾	20	18⅛	12	13/16	¾	3	
12	32	16	16	18	16	18	15⅞	10	13/16	¾	3	24	22⅛	16	15/16	⅞	3¼	
14	36	18	18	20	18	20	18⅛	12	13/16	¾	3	26	24⅛	18	15/16	⅞	3¾	
16	40	20	20	24	20	22	20⅛	14	13/16	¾	3¼	30	28⅛	20	15/16	⅞	4	

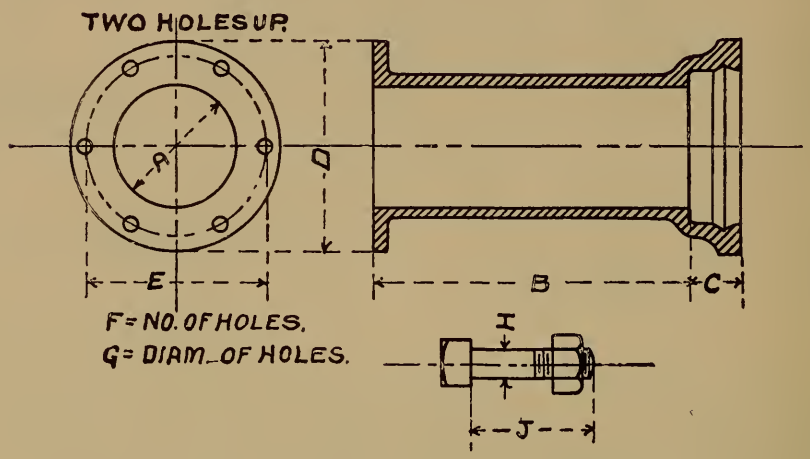
FLANGED CROSSES.



The distances **E** and **B** represent our standard dimensions, and are the shortest distances we can furnish from our patterns. One or more of the dimensions marked **C, D, F,** and **G** may be changed to suit any special conditions. Any changes from the standard given in the table will constitute an extra. It is our practice to drill crosses with two holes up, as shown in the engraving. If a cross is to lie horizontally the drilling will still be with two holes up, which will make them at right angles to the position shown in the engraving.

Diameter.	Face to Face.	Face to Centre.		Face to Face.	Face to Centre.		Diameter of Flange.	Diameter of Bolt Circle.	Number of Bolt Holes.	Diameter of Bolt Holes.	BOLTS.		PRICE.
											Diameter.	Length.	
A	B	C	D	E	F	G	H	J	K	L	M	N	
4	14	7	7	14	7	7	9	7¼	5	11/16	5/8	2⅜	
5	16	8	8	16	8	8	10	8¼	5	11/16	5/8	2⅜	
6	16	8	8	16	8	8	11	9¼	6	11/16	5/8	2⅝	
7	18	9	9	18	9	9	12	10¼	6	13/16	¾	2¾	
8	18	9	9	18	9	9	13	11¼	8	13/16	¾	2¾	
10	22	11	11	22	11	11	16	13⅞	8	13/16	¾	2⅜	
12	24	12	12	24	12	12	18	15⅞	10	13/16	¾	3	
14	26	13	13	26	13	13	20	18⅛	12	13/16	¾	3	
16	30	15	15	30	15	15	22	20⅛	14	13/16	¾	3¼	
18	32	16	16	32	16	16	24	22⅛	16	15/16	⅞	3¼	
20	36	18	18	36	18	18	26	24⅛	18	15/16	⅞	3¾	
22	38	19	19	38	19	19	28	26⅛	18	15/16	⅞	4	
24	40	20	20	40	20	20	30	28⅛	20	15/16	⅞	4	

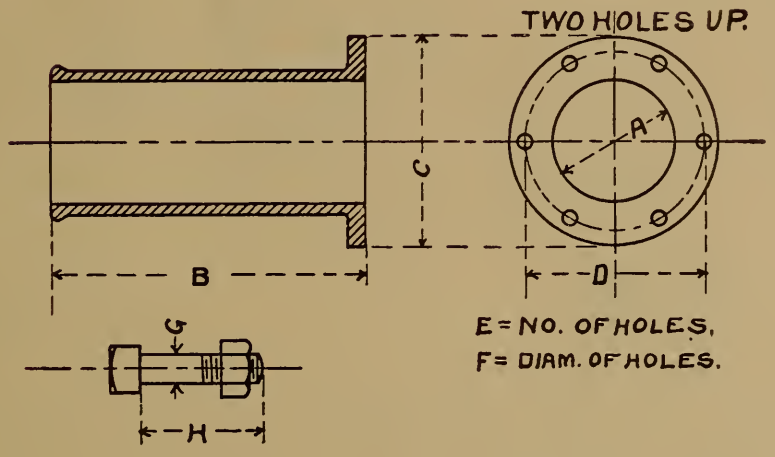
COMBINED FLANGE AND BELL.



The diameter of the flange corresponds to that of our standard work; the drilling also corresponds to our standard. The proportions of the bell are those which correspond to Eastern practice. The distance **B** can be varied to suit any particular case.

Diameter. A	Length. B	Length of Bell. C	Diameter of Flange. D	Diameter of Bolt Circle. E	Number of Bolt Holes. F	Diameter of Bolt Holes. G	BOLTS. Diameter. H	BOLTS. Length. J	PRICE.
4	12	3	9	7¼	5	11/16	5/8	2⅜	
5	14	3	10	8¼	5	11/16	5/8	2⅜	
6	16	3	11	9¼	6	11/16	5/8	2⅝	
7	18	3	12	10¼	6	13/16	¾	2¾	
8	20	3	13	11¼	8	13/16	¾	2¾	
10	22	3	16	13⅞	8	13/16	¾	2¾	
12	24	3¼	18	15⅞	10	13/16	¾	3	
14	26	3¼	20	18⅛	12	13/16	¾	3	
16	28	3½	22	20⅛	14	13/16	¾	3¼	
18	30	3½	24	22⅛	16	15/16	⅞	3¼	
20	32	3½	26	24⅛	18	15/16	⅞	3¾	
22	34	3¾	28	26⅛	18	15/16	⅞	4	
24	36	3¾	30	28⅛	20	15/16	⅞	4	

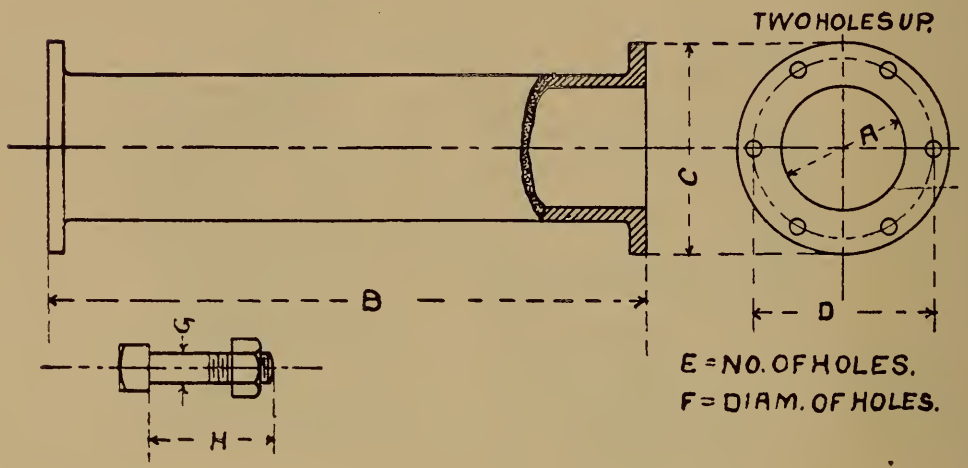
COMBINED FLANGE AND SPIGOT.



These flanges correspond in diameter and drilling with our regular standard work. The distance **B** may be varied to suit the needs of any particular case.

Diameter. A	Length. B	Diameter of Flange. C	Diameter of Bolt Circle. D	Number of Bolt Holes. E	Diameter of Bolt Holes. F	BOLTS. Diameter. G	BOLTS. Length. H	PRICE.
4	12	9	7¼	5	11/16	5/8	2⅜	
5	14	10	8¼	5	11/16	5/8	2⅜	
6	16	11	9¼	6	11/16	5/8	2⅝	
7	18	12	10¼	6	13/16	¾	2¾	
8	20	13	11¼	8	13/16	¾	2¾	
10	22	16	13⅜	8	13/16	¾	2¾	
12	24	18	15⅜	10	13/16	¾	3	
14	26	20	18⅛	12	13/16	¾	3	
16	28	22	20⅛	14	13/16	¾	3¼	
18	30	24	22⅛	16	15/16	⅞	3¼	
20	32	26	24⅛	18	15/16	⅞	3¾	
22	34	28	26⅛	18	15/16	⅞	4	
24	36	30	28⅛	20	15/16	⅞	4	

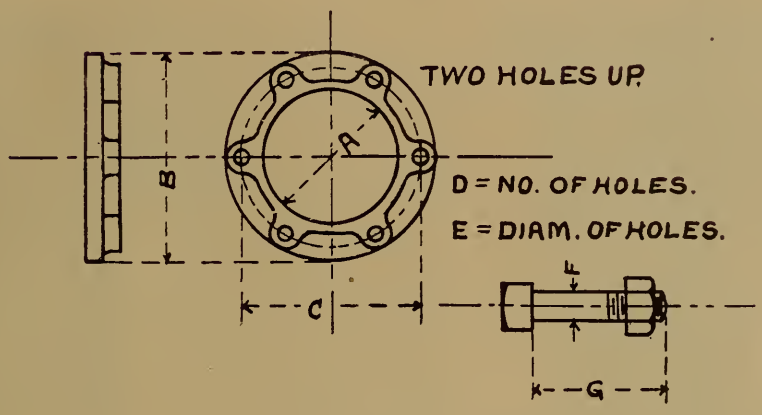
FLANGED PIPE.



The diameters of the flanges and the drilling correspond to our standard. The length B can be made of any length not exceeding 10 feet. The thickness of the pipes is based upon a head of 300 feet, or 150 pounds pressure, including the usual allowance for friction.

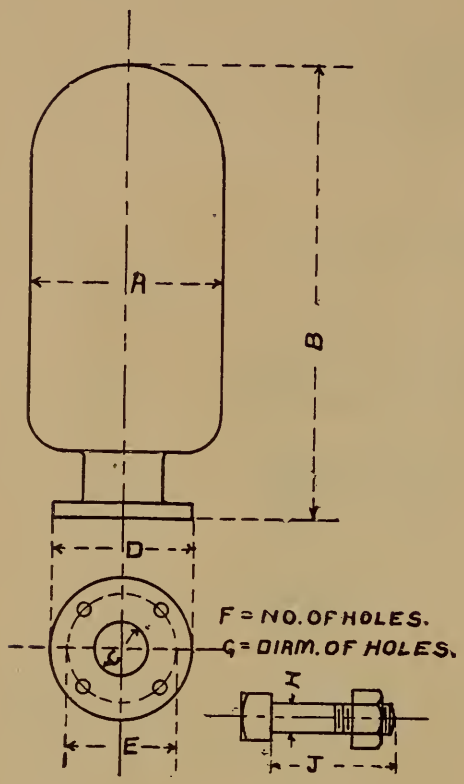
Diameter. A	Length. B	Diameter of Flange. C	Diameter of Bolt Circle. D	Number of Bolt Holes. E	Diameter of Bolt Holes. F	BOLTS. Diameter. G	BOLTS. Length. H	PRICE.
4		9	7¼	5	11/16	5/8	2⅜	
5		10	8¼	5	11/16	5/8	2⅜	
6		11	9¼	6	11/16	5/8	2⅝	
7		12	10¼	6	13/16	¾	2¾	
8		13	11¼	8	13/16	¾	2¾	
10		16	13⅜	8	13/16	¾	2¾	
12		18	15⅜	10	13/16	¾	3	
14		20	18⅛	12	13/16	¾	3	
16		22	20⅛	14	13/16	¾	3¼	
18		24	22⅛	16	15/16	⅞	3¼	
20		26	24⅛	18	15/16	⅞	3¾	
22		28	26⅛	18	15/16	⅞	4	
24		30	28⅛	20	15/16	⅞	4	

PIPE-FLANGES.



These flanges are extra heavy, and are made of a diameter and number of holes suited to our standard work. These flanges are all cut in a lathe, so that the thread is always at right angles to the face, the taper of the thread in the flanges being guided by a taper attachment on the lathe, making a very much better flange for large work than those ordinarily had in supply depots.

Diameter of Wrought-Iron Pipe. A	Diameter of Flange. B	Diameter of Bolt Circle. C	Number of Bolt Holes. D	Diameter of Bolt Holes. E	BOLTS. Diameter. F	BOLTS. Length. G	PRICE.
1	4	3	4	9/16	1/2	2 1/2	
1 1/4	4 1/2	3 1/2	4	9/16	1/2	2 3/4	
1 1/2	4 3/4	3 5/8	4	9/16	1/2	2 3/4	
2	5 7/8	4 1/2	4	11/16	5/8	2 7/8	
2 1/2	6 1/2	5	4	11/16	5/8	3 7/8	
3	8	6 1/4	4	11/16	5/8	3 7/8	
3 1/2	8 1/2	6 3/4	4	11/16	5/8	3 7/8	
4	9	7 1/4	5	11/16	5/8	4 1/8	
4 1/2	9 1/2	7 3/4	5	11/16	5/8	4 1/8	
5	10	8 1/4	5	11/16	5/8	4 3/8	
6	11	9 1/4	5	11/16	5/8	4 3/8	
7	12	10 1/4	6	13/16	3/4	4 3/4	
8	13	11 1/4	8	13/16	3/4	5	
10	16	13 7/8	8	13/16	3/4	5 1/2	
12	18	15 7/8	10	13/16	3/4	6	



AIR-CHAMBERS.

The engraving on this page shows the general design adopted by us for air-chambers, the table giving our standard dimensions. These chambers are made of cast iron, and tested to 150 pounds per square inch. The diameter of the flange D corresponds to our own practice, but this diameter can be varied to suit the needs of a customer, provided the diameter is not less than that given in the table.

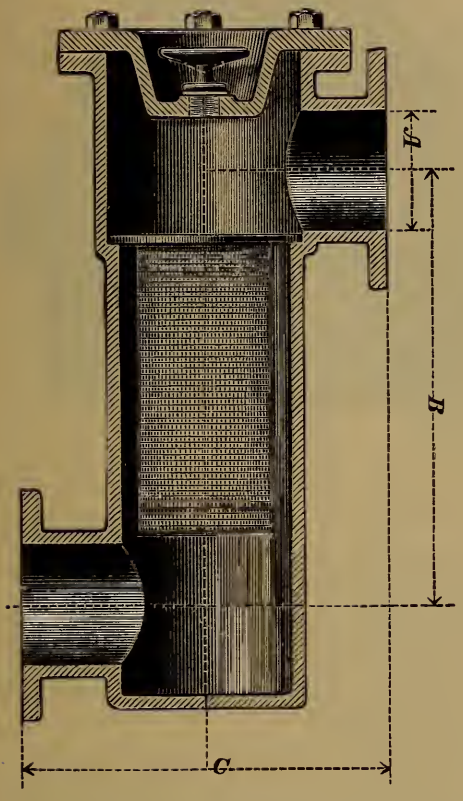
Diameter. A	Height. B	Diameter of Opening. C	Diameter of Flange. D	Diameter of Bolt Circle. E	Number of Bolt Holes. F	Diameter of Bolt Holes G	BOLTS. Diameter. H	BOLTS. Length. J	PRICE.
8	18	2½	6½	5	4	11/16	5/8	2⅜	
10	22¾	3¼	8	6¼	4	11/16	5/8	2⅜	
12	26⅞	4¾	10	8¼	5	11/16	5/8	2⅝	
14	31	5	10	8¼	5	11/16	5/8	2⅝	
16	36	5	10	8¼	5	11/16	5/8	2⅞	
18	41	6	11	9¼	6	11/16	5/8	2⅞	
20	45	7	13	11¼	8	13/16	¾	3¼	
22	50	7	13	11¼	8	13/16	¾	3¼	
24	55	9	16	13⅞	8	13/16	¾	3¼	

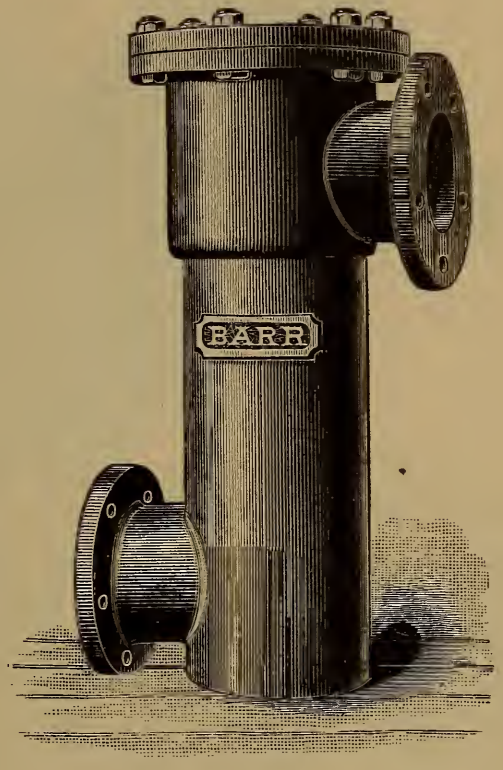
VACUUM-CHAMBERS.

It is our practice to use the same pattern for vacuum-chambers as employed for air-chambers, so that the dimensions will be the same for both.

COMBINED SIDE-PIPE AND STRAINER,

For Pumps of 12 and 18 Inches Stroke.



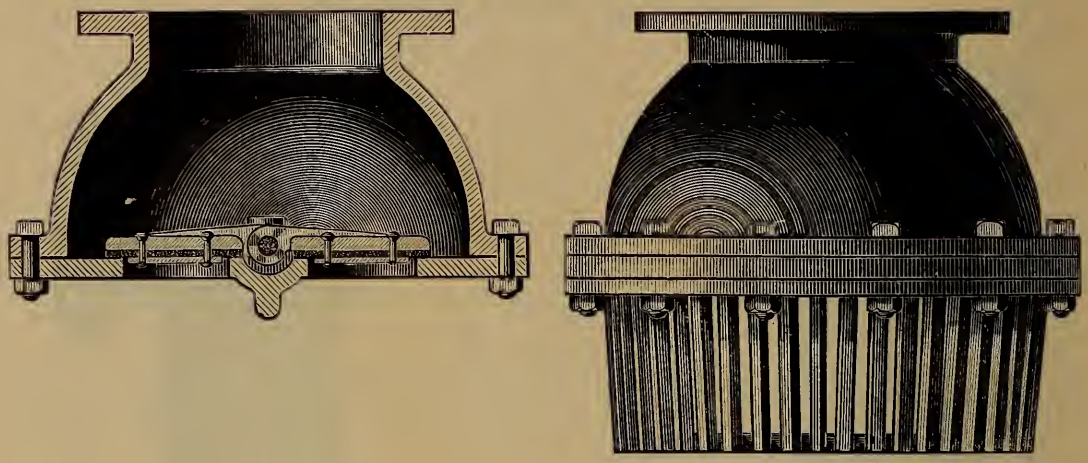


If the suction-pipe is not provided with a proper strainer at the end from which the water-supply is had, a combined side-pipe and strainer, as shown in the engraving, will be useful in collecting leaves, twigs, fish, and other floating matter which ought not to pass through the pump. The strainer is made of brass wire netting, and can be lifted out through the top of the side-pipe by removing the cover.

Water-Ends for which Side-Pipes are Adapted.	Diameter of Suction-Pipe. A	Centre to Centre. B	Face to Face. Flanges. C	DIAMETERS. Flange. A	Bolt Circle.	Bolt Holes.	Bolts.	PRICE.
6 x 12	5	18	15	10	8¼	11/16	5—⅝	
7 x 12	6	19	15	11	9¼	11/16	6—⅝	
8 x 12	6	20	16	11	9¼	11/16	6—⅝	
10 x 12	8	22	16	13	11¼	13/16	8—¾	
10 x 18	10	26	20	16	13⅜	13/16	8—¾	
12 x 12	10	26	20	16	13⅜	13/16	8—¾	
12 x 18	12	28	22	18	15⅞	13/16	10—¾	
14 x 12	12	28	22	18	15⅞	13/16	10—¾	
14 x 18	12	28	22	18	15⅞	13/16	10—¾	

We can furnish horizontal strainers to attach to the suction-pipe, designs and prices for which will be sent on application.

FOOT-VALVES.

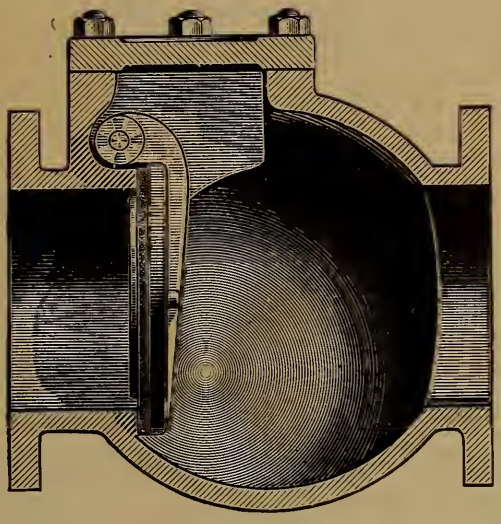


Our standard foot-valve is shown in the sectional elevation, the valve swinging on a throughgoing brass bolt in the centre. The valve faces are of leather held in place by brass guards and brass rivets. The valve-plate is surfaced so as to make a tight joint. These valves are of sufficient strength to allow for leakage passing the valves of the pump, but for the larger sizes we can attach a relief-valve on the side of the chamber so as to relieve the shell of overpressure.

We can attach a cast-iron strainer, as shown in the engraving, the openings being amply large, so that obstructions, such as twigs, leaves, etc., will not prevent the flow of sufficient water through the openings to supply the pumping machinery.

Diameter of Opening.	DIAMETERS.				PRICE.	
	Flange.	Bolt Circle.	Bolt Holes.	Bolts.	Without Strainer.	With Strainer.
4	9	7¼	11/16	5—⅝		
5	10	8¼	11/16	5—⅝		
6	11	9¼	11/16	6—⅝		
7	12	10¼	13/16	6—¾		
8	13	11¼	13/16	8—¾		
10	16	13⅞	13/16	8—¾		
12	18	15⅞	13/16	10—¾		
14	20	18⅛	13/16	12—¾		
16	22	20⅛	13/16	14—¾		
18	24	22⅛	15/16	16—⅞		
20	26	24⅛	15/16	18—⅞		
22	28	26⅛	15/16	18—⅞		
24	30	28⅛	15/16	20—⅞		

CHECK-VALVES.



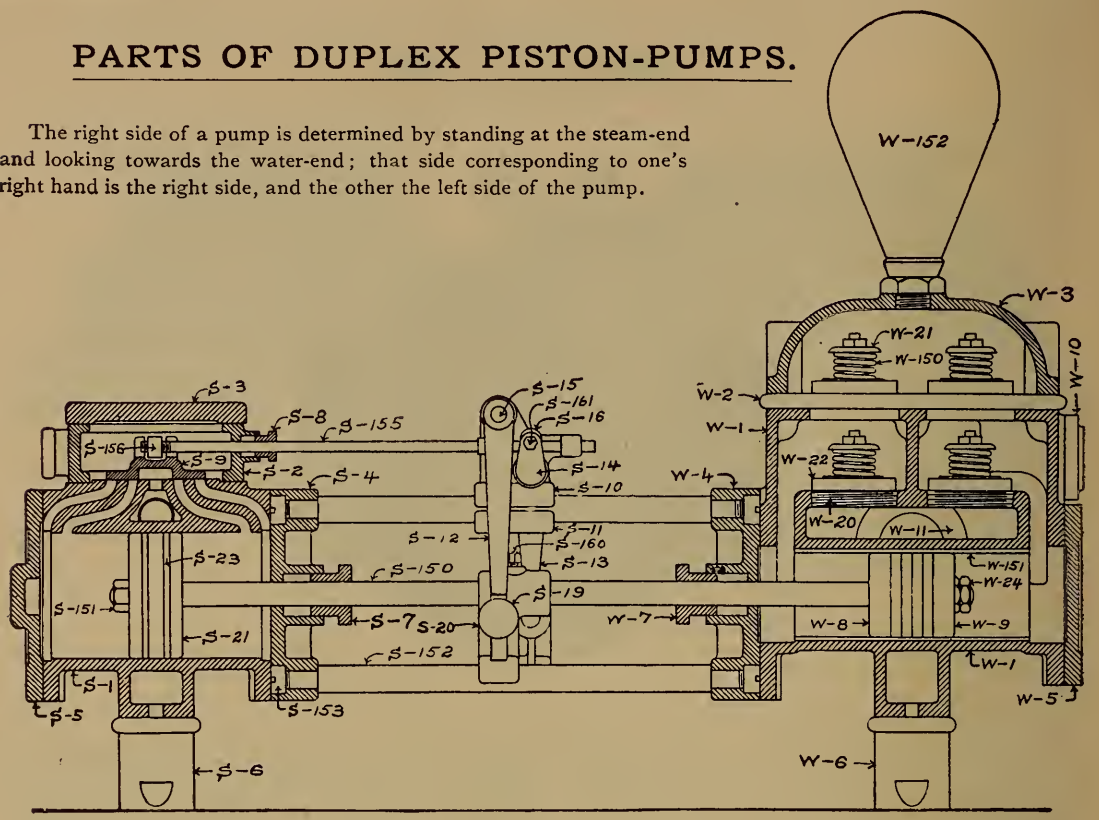
All of our check-valves have straightway openings, as shown in the engraving. The dimension of the chamber is such that a full area of opening is had when the valve is on an angle of less than 45 degrees. This valve is fitted with a hand-hole plate, so that the condition of the valve may be ascertained at any time. The pivot of the valve is a throughgoing brass bolt with nuts on the outside, so that it can be withdrawn and the valve removed from its seat for examination and repair.

These valves are extra heavy, and intended for water-works service.

Diameter of Opening.	Length End to End.	DIAMETERS.				PRICE.
		Flanges.	Bolt Centre.	Bolt Holes.	Bolts.	
4	11	9	7¼	11/16	5—⅝	
5	12	10	8¼	11/16	5—⅝	
6	14	11	9¼	11/16	6—⅝	
7	15	12	10¼	13/16	6—¾	
8	18½	13	11¼	13/16	8—¾	
10	21	16	13⅞	13/16	8—¾	
12	23	18	15⅞	13/16	10—¾	
14	26	20	18⅛	13/16	12—¾	
16	32	22	20⅛	13/16	14—¾	
18	35	24	22⅛	15/16	16—⅞	
20	38	26	24⅛	15/16	18—⅞	
22	40	28	26⅛	15/16	18—⅞	
24	42	30	28⅛	15/16	20—⅞	

PARTS OF DUPLEX PISTON-PUMPS.

The right side of a pump is determined by standing at the steam-end and looking towards the water-end; that side corresponding to one's right hand is the right side, and the other the left side of the pump.



The engraving on this page represents a sectional elevation of a **Duplex Piston-Pump** for sizes less than 12 inches stroke, each part being numbered.

Parts belonging to the steam-end and valve-motion have the letter "**S**" prefixed to all numbers, and parts of the water-end have the letter "**W**" prefixed. The symbol and the number are common to all pumps, no matter what the size may be.

The brass linings, marked "**W-151,**" are for all pumps of less than 12 inches stroke, made of seamless-drawn brass; this is drawn to a gauge, but is not sufficiently near to size to make a driving fit without slightly reducing the outside of the tube, which can be done by filing in a lathe.

Be careful to specify when ordering parts belonging to the water-pistons exactly what kind of piston you have,—that is to say, whether for fibrous packing, whether it is fitted with cup-leather packings, or with metal packings. This information is to verify our shop register, and will save time in furnishing parts.

The size of a pump and its number will be found cast on the steam-chest cover of each pump; these figures should always accompany an order, that the pump may be identified on our books and the order properly filled.

LIST OF PARTS OF DUPLEX PISTON-PUMPS LESS THAN 12 INCHES STROKE.

In ordering parts give name, symbol, and number as below; also, the size and shop number of the pump, which will be found cast on the steam-chest cover.

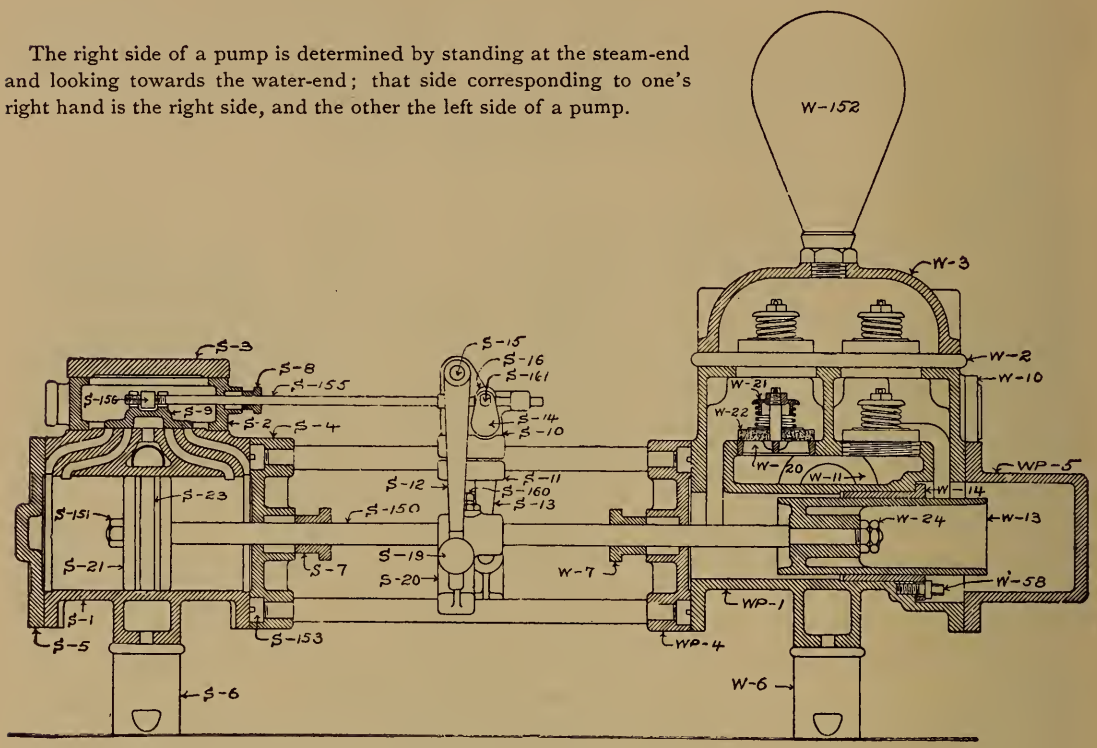
NAME.	Symbol.	Number.
Steam-Cylinders	S	1
Steam-Chest	S	2
Steam-Chest Cover	S	3
Cylinder-Head (Inside)	S	4
Cylinder-Head (Outside)	S	5
Steam-Cylinder Foot	S	6
Piston-Rod Gland	S	7
Valve-Rod Gland	S	8
Slide-Valve	S	9
Cross-Stand	S	10
Cross-Stand Clamp	S	11
Long Lever	S	12
Short Lever	S	13
Lower-Rock Shaft	S	14
Upper-Rock Shaft	S	15
Valve-Rod Head	S	16
Valve-Rod Link (Short)	S	17
Valve-Rod Link (Long)	S	18
Cross-Head Pin	S	19
Cross-Head	S	20
Piston	S	21
Piston-Rings	S	23
Bed-Plate	S	29
Piston-Rod	S	150
Piston-Rod Nut	S	151
Tie-Rod	S	152
Tie-Rod Nut	S	153
Valve-Rod	S	155
Slide-Valve Nut	S	156
Valve-Rod Head-Pin and Nut	S	157
Cross-Head Set-Screw	S	160
Rocker-Arm Pin and Nut	S	161
Drain-Cock	S	162

NAME.	Symbol.	Number.
Water-Cylinder	W	1
Valve-Plate	W	2
Force-Chamber	W	3
Inside Head	W	4
Outside Head	W	5
Water-Cylinder Foot	W	6
Piston-Rod Gland	W	7
Water-Piston	W	8
Water-Piston Follower	W	9
Delivery-Flange	W	10
Suction-Flange (Tapped)	W	11
Suction-Flange (Blank)	W	12
Hand-Hole Plate (Force Chamber)	W	17
Hand-Hole Plate (Body)	W	18
Valve-Seat	W	20
Valve-Nut	W	21
Valve	W	22
Valve-Plate Brass Nut	W	23
Water-Piston Nuts	W	24
Piston-Rod Socket-Wrench	W	72
Valve-Spring	W	150
Brass Lining	W	151
Copper Air-Chamber	W	152

The symbol "S" relates to steam-end and valve-motion. The symbol "W" relates to water-end.

PARTS OF DUPLEX PLUNGER-PUMPS.

The right side of a pump is determined by standing at the steam-end and looking towards the water-end; that side corresponding to one's right hand is the right side, and the other the left side of a pump.



The engraving on this page represents a sectional elevation of a **Duplex Plunger-Pump** for all sizes less than 12 inches stroke, each part being numbered.

Parts belonging to the steam-end and valve-motion have the letter "**S**" prefixed to all numbers, and parts of the water-end have the letter "**W**" prefixed. The symbol and the number are common to all pumps, no matter what the size may be.

The plunger-rings fit in bored recesses in the water-cylinders, and as these are made to gauge any ring will fit its water-cylinder.

In ordering new rings to fit an old plunger allowance should be made for turning off the plunger, and any such allowance for refitting should be correctly stated in any orders for new plunger-rings.

When both plunger and ring are ordered at one time they will be fitted to each other before leaving our works.

The size of a pump and its number will be found cast on the steam-chest cover of each pump; these figures should always accompany an order, that the pump may be identified on our books and the order properly filled.

LIST OF PARTS OF DUPLEX PLUNGER-PUMPS LESS THAN 12 INCHES STROKE.

In ordering parts give name, symbol, and number as below; also, the size and shop number of the pump, which will be found cast on the steam-chest cover.

NAME.	Symbol.	Number.
Steam-Cylinders	S	1
Steam-Chest	S	2
Steam-Chest Cover	S	3
Cylinder-Head (Inside)	S	4
Cylinder-Head (Outside)	S	5
Steam-Cylinder Foot	S	6
Piston-Rod Gland	S	7
Valve-Rod Gland	S	8
Slide-Valve	S	9
Cross-Stand	S	10
Cross-Stand Clamp	S	11
Long Lever	S	12
Short Lever	S	13
Lower-Rock Shaft	S	14
Upper-Rock Shaft	S	15
Valve-Rod Head	S	16
Valve-Rod Link (Short)	S	17
Valve-Rod Link (Long)	S	18
Cross-Head Pin	S	19
Cross-Head	S	20
Piston	S	21
Piston-Rings	S	23
Bed-Plate	S	29
Piston-Rod	S	150
Piston-Rod Nut	S	151
Tie-Rod	S	152
Tie-Rod Nut	S	153
Valve-Rod	S	155
Slide-Valve Nut	S	156
Valve-Rod Head-Pin and Nut	S	157
Cross-Head Set-Screw	S	160
Rocker-Arm Pin and Nut	S	161
Drain-Cock	S	162

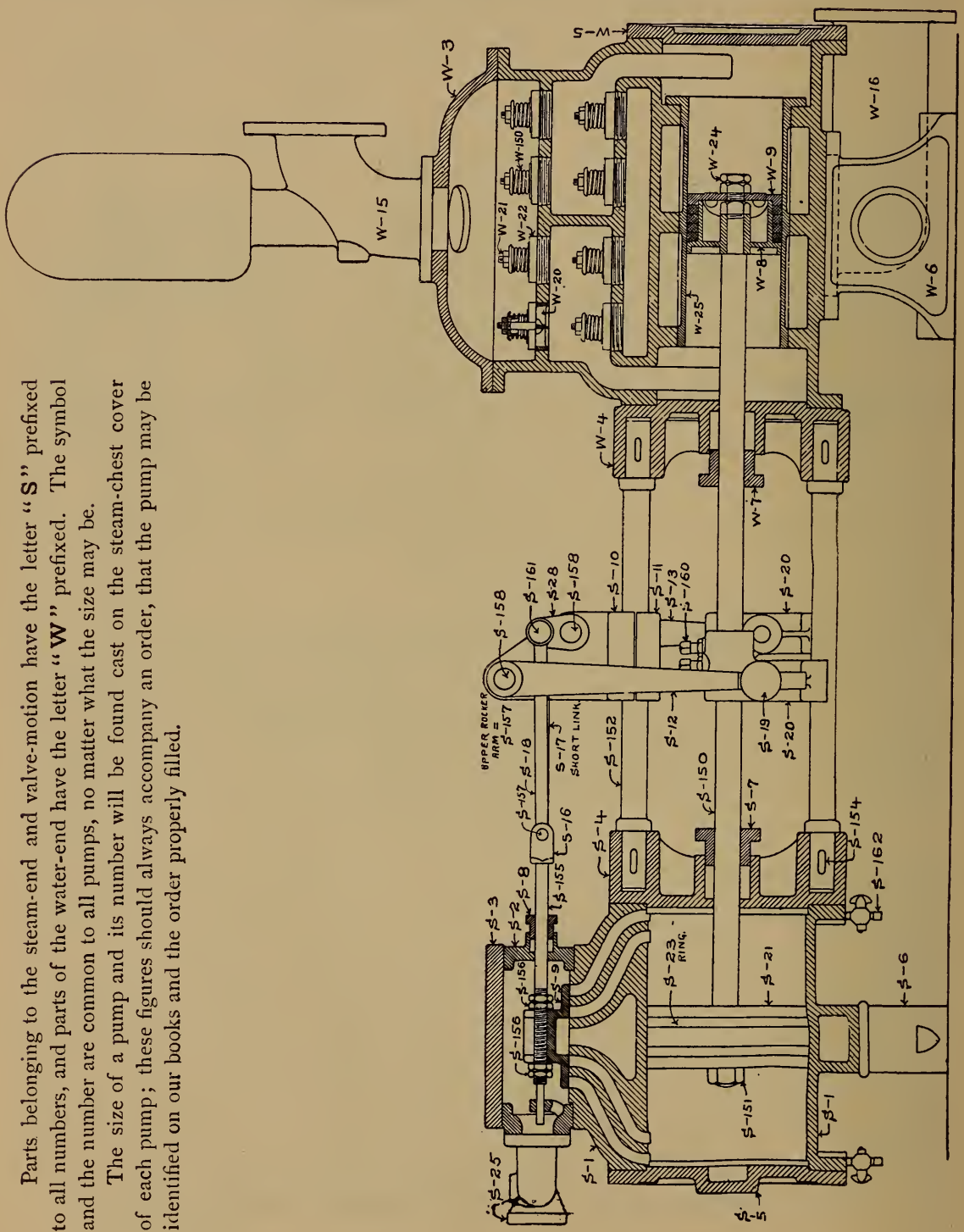
NAME.	Symbol.	Number.
Water-Cylinder	W P	1
Valve-Plate	W	2
Force-Chamber	W	3
Inside Head	W P	4
Outside Head	W P	5
Water-Cylinder Foot	W	6
Piston-Rod Gland	W	7
Delivery-Flange	W	10
Suction-Flange (Tapped)	W	11
Suction-Flange (Blank)	W	12
Plunger	W	13
Plunger-Ring	W	14
Hand-Hole Plate (Force Chamber)	W	17
Hand-Hole Plate (Body)	W	18
Valve-Seat	W	20
Valve-Nut	W	21
Valve	W	22
Valve-Plate Brass Nut	W	23
Water-Plunger Nuts	W	24
Plunger-Ring Tap-Bolts	W	58
Piston-Rod Socket-Wrench	W	72
Valve-Spring	W	150
Brass Lining	W	151
Copper Air-Chamber	W	152

The symbol "S" relates to steam-end and valve-motion. The symbol "W" relates to water-end.

PARTS OF DUPLEX PISTON-PUMPS OF 12 INCHES STROKE.

Parts belonging to the steam-end and valve-motion have the letter "**S**" prefixed to all numbers, and parts of the water-end have the letter "**W**" prefixed. The symbol and the number are common to all pumps, no matter what the size may be.

The size of a pump and its number will be found cast on the steam-chest cover of each pump; these figures should always accompany an order, that the pump may be identified on our books and the order properly filled.

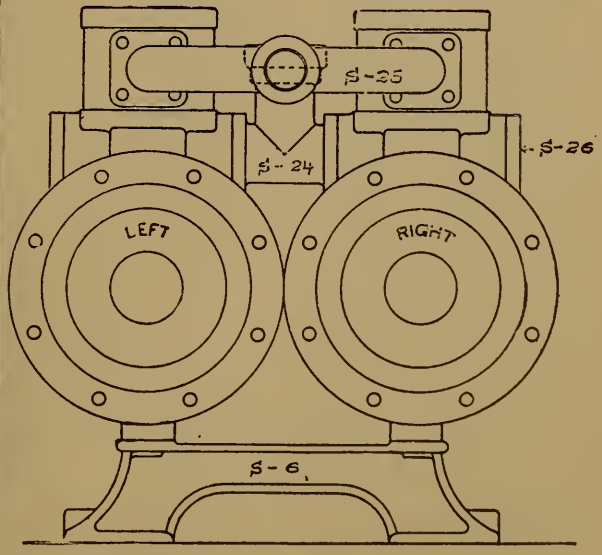


LIST OF PARTS OF DUPLEX PISTON-PUMPS OF 12 INCHES STROKE.

In ordering parts give name, symbol, and number as below; also, the size and shop number of the pump, which will be found cast on the steam-chest cover.

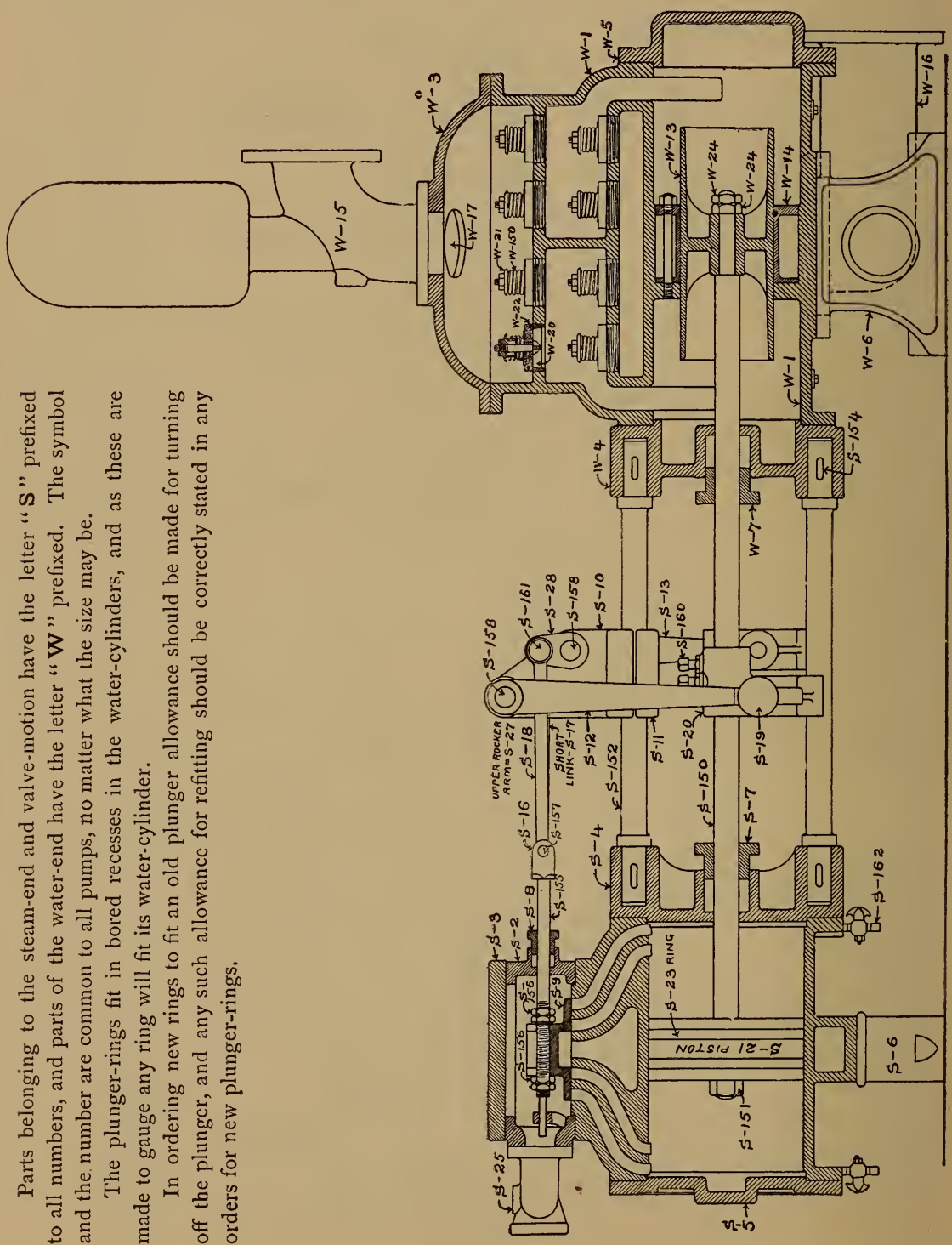
NAME.	Symbol.	Number.
Steam-Cylinder	S	1
Steam-Chest	S	2
Steam-Chest Cover	S	3
Steam-Cylinder Head (Inside)	S	4
Steam-Cylinder Head (Outside)	S	5
Steam-Cylinder Foot	S	6
Piston-Rod Gland	S	7
Valve-Rod Gland	S	8
Slide-Valve	S	9
Cross-Stand	S	10
Cross-Stand Clamp	S	11
Long Lever	S	12
Short Lever	S	13
Valve-Rod Head	S	16
Valve-Rod Link (Short)	S	17
Valve-Rod Link (Long)	S	18
Cross-Head Pin	S	19
Cross-Head	S	20
Piston	S	21
Piston-Rings	S	23
Exhaust-Tee	S	24
Steam-Pipe	S	25
Exhaust-Blank Flange	S	26
Upper Rocker-Arm	S	27
Lower Rocker-Arm	S	28
Bed-Plate	S	29
Piston-Rod	S	150
Piston-Rod Nut	S	151
Tie-Rod	S	152
Tie-Rod Nut	S	153
Tie-Rod Key	S	154
Valve-Rod	S	155
Slide-Valve Nut	S	156
Valve-Rod Head-Pin and Nut	S	157
Rock-Shaft	S	158
Cross-Head Set-Screw	S	160
Rocker-Arm Pin and Nut	S	161
Drain-Cock	S	162

NAME.	Symbol.	Number.
Water-Cylinder	W	1
Force-Chamber	W	3
Inside Water-Cylinder Head	W	4
Outside Water-Cylinder Head	W	5
Water-Cylinder Foot	W	6
Piston-Rod Gland	W	7
Packed Water-Piston	W	8
Packed Water-Piston Follower	W	9
Delivery-Tee	W	15
Suction-Pipe	W	16
Hand-Hole Plate (Force Chamber)	W	17
Hand-Hole Plate (Body)	W	18
Valve-Seat	W	20
Valve-Nut	W	21
Valve	W	22
Water-Piston Nuts	W	24
Piston-Rod Socket-Wrench	W	72
Valve-Spring	W	150



The symbol "S" relates to steam-end and valve-motion. The symbol "W" relates to water-end.

PARTS OF DUPLEX PLUNGER-PUMPS OF 12 INCHES STROKE.



Parts belonging to the steam-end and valve-motion have the letter "S" prefixed to all numbers, and parts of the water-end have the letter "W" prefixed. The symbol and the number are common to all pumps, no matter what the size may be.

The plunger-rings fit in bored recesses in the water-cylinders, and as these are made to gauge any ring will fit its water-cylinder.

In ordering new rings to fit an old plunger allowance should be made for turning off the plunger, and any such allowance for refitting should be correctly stated in any orders for new plunger-rings.

LIST OF PARTS OF DUPLEX PLUNGER-PUMPS OF 12 INCHES STROKE.

In ordering parts give name, symbol, and number as below; also, the size and shop number of the pump, which will be found cast on the steam-chest cover.

NAME.	Symbol.	Number.
Steam-Cylinder	S	1
Steam-Chest	S	2
Steam-Chest Cover	S	3
Steam-Cylinder Head (Inside)	S	4
Steam-Cylinder Head (Outside)	S	5
Steam-Cylinder Foot	S	6
Piston-Rod Gland	S	7
Valve-Rod Gland	S	8
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Cross-Stand	S	10
Cross-Stand Clamp	S	11
Long Lever	S	12
Short Lever	S	13
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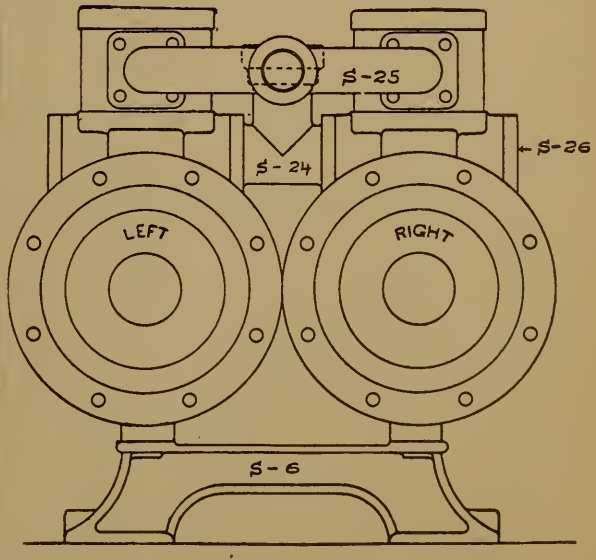
NAME.	Symbol.	Number.
Water-Cylinder	W	1
Force-Chamber	W	3
Inside Water-Cylinder Head	W	4
Outside Water-Cylinder Head	W	5
Water-Cylinder Foot	W	6
Piston-Rod Gland	W	7
Plunger	W	13
Plunger-Ring	W	14
Delivery-Tee	W	15
Suction-Pipe	W	16
Hand-Hole Plate (Force Chamber)	W	17
Hand-Hole Plate (Body)	W	18
Valve-Seat	W	20
Valve-Nut	W	21
Valve	W	22
Water-Plunger Nuts	W	24
Piston-Rod Socket-Wrench	W	72
Valve-Spring	W	150



The symbol "S" relates to steam-end and valve-motion. The symbol "W" relates to water-end.

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